AQUIFER PROTECTION PLAN
CROTON-ON-HUDSON WELL FIELD
CROTON-ON-HUDSON, NEW YORK

Prepared for the
Village of Croton-on-Hudson
Croton-on-Hudson, New York

January 1989

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CONTENTS

CONTENTS (Continued)

TABLES

FIGURES

APPENDICES

AQUIFER PROTECTION PLAN
CROTON-ON-HUDSON WELL FIELD
CROTON-ON-HUDSON, NEW YORK

INTRODUCTION

In January 1988, the Village of Croton-on-Hudson retained Geraghty & Miller, Inc. to prepare a ground-water protection plan for the Croton-on-Hudson well field. The village wishes to establish certain regulations to protect the well field and the aquifer from potential pollution and thereby preserve the quality and quantity of the water supply for present and future generations.

In this report, potential sources of contamination are described and three aquifer protection zones are established and prioritized according to the sensitivity of different parts of the watershed to contamination. These three zones, in order of decreasing restrictions, are defined as follows: (1 wellhead protection area, (2) aquifer recharge area, and (3) watershed area. These three zones are delineated on Figure 1 and are called the protection area when referred to as a whole.

For planning purposes, Geraghty & Miller has also prepared maps of soil suitability for septic tanks (Figure 2), distribution of septic tanks and sewers (Figure 3), and bedrock geologic conditions (Figure 4). Recommendations for protecting the aquifer are presented below, and a draft

ground-water protection ordinance, based on State of New York guidelines, is provided in Appendix A.

According to the 1980 census, the Village of Croton-on-Hudson is a community of 6,889 people, approximately 6,000 of whom are served by the village well field, which is located at the northern portion of the village within the Croton River Valley aquifer. The well field currently pumps between 1.0 and 1.25 million gallons a day (mgd). Residences in the northern section of the village use private wells. Most of the aquifer protection area lies within the Town of Cortlandt. This aquifer protection plan evaluates the potential impact of the entire contributary watershed and recharge zone on water quality in the well field. The potential sources of contamination to the well field are discussed in the following section. Specific recommendations for reducing these sources are provided in the section "Delineation of the Zones of Protection."

POTENTIAL SOURCES OF CONTAMINATION

Potential contamination can be discussed in terms of non-point and point sources. A point source pollutant results from a regulated facility, such as a sewage treatment plant. There are no point sources in the Croton well field protection area. The potential non-point sources of contamination within the protection area are septic systems,

sewers, road salt, storm-water runoff, animal waste, fertilizers, herbicides and pesticides, leaking underground petroleum storage tanks and spills. Each one of these sources is discussed below.

Septic Systems

The advantages of cesspools, septic tanks, and leaching fields include their relatively inexpensive installation and maintenance, the generally low pollution loadings to ground-water in low-density residential areas, and ground-water recharge. However, if the septic system's ability to attenuate the contaminants naturally is inadequate, pollutants may seep into the ground water and into surface-water bodies and degrade the water quality.

The primary contaminants of a septic system include nitrogen, organic chemicals, metals, bacteria, and viruses. Typically, some of the nitrate-nitrogen loading is reduced in the septic system, although not all is removed. Organic chemicals enter the system via cesspool cleaning liquids, solvents and degreasers, gasoline and petroleum products, foaming agents, and other organic chemicals. Cesspool cleaning liquids have historically constituted the bulk of the halogenated hydrocarbons in household discharges (examples of halogenated hydrocarbons in cesspool cleaning liquids are 1,1,1-trichloroethene, methylene chloride, and dichlorobenzene). Bacterial and viral contaminants are

usually trapped beneath the leaching field, although with certain geologic conditions, such as soil with low organic content and fractured bedrock, they can travel longer distances.

Most problems that develop from septic systems result from one or more of the following conditions: improper siting, inadequate depth to water, improper use, poor maintenance, and, ultimately, improper disposal of the scavenger waste that is produced by the septic systems. Septic systems should be installed only on properties that are located outside the 100-year floodplain. Storm water should be directed away from the septic area.

Maintenance procedures are important, especially for systems that were not optimally installed. Additives to the system, such as enzymes, should be avoided; the products that are sold for the purpose of septic maintenance do not improve the performance of the septic tank nor do they reduce the need for routine maintenance (LIRPB 1984). Toxic household chemicals should not be discharged into the tank as a small amount of a toxic chemical can kill anerobic bacteria, which aid in the decomposition process, and can cause partial or complete loss of treatment for up to 3 weeks. Grease should not be discharged into the septic system. The tank should be pumped out every 2 or 3 years to prevent clogging, and the leaching system must be kept in

good repair. An alternative leaching area should be constructed if the original one is not working properly.

To educate the public about proper septic tank installation and maintenance procedures, a townwide informational program could be developed and, a septic maintenance district could be established using tax dollars (Tannenbaum, pers. comm., 1988). The septic maintenance district would be set up in accordance with the New York State General Municipal Laws that allow the creation of wastewater disposal districts. With such maintenance programs in place, reminders can be sent periodically to residents when their septic systems need to be pumped out, or the village can organize and carry out the maintenance program.

A map showing soil suitability for septic tanks within the protection area, based on the U.S. Department of Agriculture, Soil Conservation Service preliminary soil maps (1986), and the Westchester County Soil Potential Ratings Handbook (Vinar and Schlosser 1984) is presented on Figure 2. The soils are rated as high, medium, or low suitability for septic tank construction. Those soils rated as high or medium suitability can accommodate septic systems without alteration of the soil conditions beneath the system. Areas with low suitability will need engineering intervention to improve the soil conditions beneath the system. Septic

tanks should preferably be installed in areas rated as high or medium suitability. Areas characterized by low suitability should be considered for sewer installation. This map (Figure 2) can help protect the well field by identifying suitable areas for septic system installations so that future contamination will be less likely.

Sewers

A small portion of Zone 3 of the protection area has sewers (Figure 3). These sewer systems should be evaluated to determine whether leakage is within U.S. Environmental Protection Agency (USEPA) infiltration guidelines; excessive leakage could contribute pathogens and other contaminants to the ground water. Should the sewer system be extended into Zone 2 of the protection area at any future time, no leakage should be tolerated.

Road Salt (Halite)

To ensure the safety and lives of motorists, highway authorities keep the roads and highways clear of snow and ice by applying either halite (sodium chloride) or a mixture of sand and halite and, at times, calcium chloride. These applications may introduce ions found in the halite and the calcium chloride to the surface water and ground water, thereby affecting the drinking-water quality. Sodium and chloride ions are fairly nonreactive and can persist for centuries dissolved in the ground water. While it is

preferable to use calcium chloride from an environmental standpoint, it costs several times more than halite.

Salt management guidelines can help to reduce the impact on the environment. These management practices include planning and mapping of salt-spreading routes so that operators are familiar with the particular problems of each route and will not duplicate salt application by other drivers. Proper application, proper timing of salt application before the storm becomes too severe, detailed record keeping, and equipment maintenance are important for effective use of this potential contaminant. The Town of Cortlandt uses a guide of 1,000 pounds of halite per mile, plus a suitable amount of sand and calcium chloride. However, when halite is used straight, rather than mixed with sand, less total halite is required to melt the ice. The lowest temperature where halite will melt ice is -6°F.

Halite (salt) storage does not appear to be a problem in the protection area because the salt storage locations are outside of the watershed. The salt for the Village of Croton-on-Hudson is stored in the southern part of the village behind the village garage, and the salt for the Town of Cortlandt is stored at Arlo Lane off Bear Mountain Parkway. Both salt storage locations are outside of the watershed.

Storm-Water Runoff

Storm-water runoff is the part of the total precipitation that flows over the land surface. The amount of storm-water runoff chiefly depends on the size of the impervious surface area and the existing storm-water control measures. Runoff can carry contaminants from animal waste, highways and roads, decay materials, decay products of vegetation and animal matter, fertilizers, pesticides, and by-products of industry and urban development. The highly soluble constituents, such as nitrate, chlorides, and many organic chemicals, are typically found in runoff. Runoff should be channeled so that it does not run directly into a stream or into the aquifer recharge area.

Animal Waste

The wastes of dogs, cats, horses, ducks, geese, deer, and other wildlife occur in dispersed locations. Animal waste contains nutrients and bacteria, including fecal coliform, fecal streptococci, and other pathogens that can be transported by storm-water runoff to surface waters and to the ground water. The impact of animal waste on the environment, including information directed to pet owners on the proper disposal of wastes, should be addressed in publicly distributed pamphlets. Wastes should be discarded away from natural and man-made storm channels, placed only in compost not used for vegetable gardens, or securely wrapped and disposed of along with other household wastes.

Fertilizers

Fertilizers include inorganic, natural organic, or synthetic chemicals that supplement the soil with materials required for plant development and growth. Organic fertilizers are decomposed by soil microorganisms to inorganic nutrient salts before they are absorbed by plant roots. The primary problems that can arise from fertilizer use are the associated health effects of high concentrations of nitrates in drinking water. Therefore, fertilizer use should be minimized by preserving the natural plant life at the site or carefully selecting the proper vegetation for the site, and using a minimum of turf. If it is necessary to use turf, it is best to choose an appropriate species for the soil and climate of the area to minimize water and fertilizer application.

Herbicides and Pesticides

There is little information on the effect of herbicides and pesticides in non-agricultural areas; however, these chemicals could accumulate in the environment from private homeowners' use or from private firms which spray herbicides and pesticides in the area. Firms which spray herbicides or pesticides should be contacted to determine the quantity applied and the frequency of applications. The Town of Cortlandt and the Village of Croton-on-Hudson do not use herbicides to clear vegetation from the sides of the roads

and they only spray pesticides rarely, usually in response to an emergency, such as a gypsy moth invasion.

Leaking Underground Petroleum Storage Tanks and Spills

All underground petroleum storage tanks within the protection area are of potential concern. Tanks greater than 1,100 gallons are regulated by the USEPA under the Superfund Amendments Reauthorization Act (SARA) and by the New York State Department of Environmental Conservation (NYSDEC). Smaller tanks, such as those typically used in private homes, are not regulated by the USEPA or the NYSDEC. A tank management plan should be developed for existing tanks at facilities that store over 1,100 gallons to address operator training, emergency response procedures, and operation and inspection procedures.

A leak from even a small hole in a tank or distribution system can affect the odor and taste of ground water and possibly cause health problems; therefore, all underground petroleum storage tanks should be tested for leaks using state-of-the-art leak detection methods (NTIS). If a tank or pipe is found to be leaking, it should be removed from the ground, and the ground water and soil must be cleaned to background levels.

All new regulated storage tank systems must use corrosion-resistant tanks and pipes, have secondary

containment, a leak monitoring system, overfill prevention equipment, fill port labels, and underground piping access ports (NYSDEC 1985). Where fire code guidelines allow, new tanks should be installed aboveground. It is recommended that new unregulated tanks be corrosion-resistant and, where possible, have a secondary containment.

Because the well field is located adjacent to a major roadway (Route 129), there is the potential for oil, chemical, or liquid waste spills to enter the well field. The possibility of spills on other roads in the protection area should also be considered, as well as potential spills associated with the filling of fuel storage tanks. The most damaging type of spill usually occurs when a large volume of oil, chemicals, or waste is discharged quickly, such as in the case of a ruptured storage tank accident involving a transport truck. A response network should be formulated in the event of a spill on Route 129 or another road.

As a preventive measure, a drainage and diversion system should also be constructed. This drainage and diversion system is included as a recommendation for Zone 3 in the section "Delineation of the Zones of Protection."

HYDROGEOLOGY

The Croton well field is located within the Croton River Valley aquifer, approximately 4,000 ft below the New Croton Dam. The study area is considered part of the New England physiographic province. The bedrock underlying the protection area is composed of crystalline rock, chiefly Inwood Marble and Manhattan Schist (Geraghty & Miller, Inc. 1970). The bedrock exposed in the Croton River Valley is heavily faulted and fractured parallel to the Croton River and a narrow band of crystalline limestone or marble is present in the deepest part of the valley. A map of the bedrock geology is presented on Figure 4. The unconsolidated alluvial valley fill deposits consist of gravel, sands, silts, and clays. The surficial deposits of the upland area consist primarily of sheets of sandy till of varying thicknesses. The U.S. Geological Survey (USGS) is currently preparing a report which will include a new bedrock map, as well as a surficial geological map of the area.

Inputs into the aquifer system include precipitation, recharge from the Croton River into the sand and gravel aquifer, underflow from the impounded dam water, recharge from the underlying fractured bedrock, and runoff from the surrounding watershed. From the standpoint of protecting the water quality of the well field, surface-water runoff

and ground-water recharge from the Croton River are considered the most important sources.

WATER QUALITY

The quality of public drinking water supplies is regulated by the USEPA and the New York State Department of Health (NYSDOH). The USEPA has issued drinking water standards and requires monitoring of the physical, chemical, and bacteriological quality of drinking water as authorized by the Safe Drinking Water Act (SDWA) of 1974 and subsequent amendments. The NYSDOH has major responsibility, called primacy, for the implementation and enforcement of the act's provisions, and their regulations for drinking water conform to those of the federal government.

Nationwide concern about the quality of drinking water has led to a substantial revision of the original SDWA. In 1986, the SDWA Amendments were issued, primarily to streamline the process for regulating organic contaminants and to strengthen ground-water protection. Problems of lead contamination in water systems have been addressed and guidelines for wellhead protection areas have been issued. In addition, several new regulations and requirements for increased monitoring and chemical analyses have been incorporated. The implications of this new legislation on the Village of Croton-on-Hudson water supply system are discussed below.

Prohibition on Use of Lead Pipes, Solder, and Flux

Section 1417 has been added to the SDWA to decrease future problems of lead contamination in water systems. This section states that "any pipe, solder, or flux used after June 19, 1986, in the installation or repair of public water systems and plumbing used for drinking water must be lead free." The phrase "lead free" is defined to mean that solder and flux can contain no more than 0.2 percent lead; pipes and fittings may contain no more than 8.0 percent. Leaded joints required for the repair of cast-iron mains are not included.

By June 1988, public water systems were to identify and provide notice to anyone who might be affected by lead contamination caused by the lead content of materials used in the distribution system or the plumbing system, or by the corrosivity of water that can cause these systems to leach lead. This notice was to be given even if the system was in compliance with the maximum contaminant level (MCL) for lead and was to meet the requirements of any public notice.

New York State was expected to start enforcement of the lead materials and the public notice requirements by June 1988. In view of this new requirement, the Village of Croton-on-Hudson should review the information on its distribution system, determine which customers might be

affected, and issue notification as required. Based on chemical data collected during August 1987, corrosivity of the water is not expected to be a problem.

Wellhead Protection

The 1986 amendments add Section 1428, which provides a program to protect ground water supplying public water system wells. This program will protect wellhead areas from contaminants that could affect public health. New York State must submit a program to the USEPA by June 1989. This program must do the following:

- Outline the roles of state, local, and public water supply agencies in carrying out the program.
- Determine wellhead protection areas for each well or well field supplying a public water system.
- Identify all potential man-made contamination sources within each wellhead protection area.
- Describe a plan to protect the wells from contamination, including technical assistance, training, control measures, or financial assistance.
- Include contingency plans to provide safe drinking water in the event of a supply becoming contaminated.
- Require that potential sources of contamination be investigated before a new well is constructed.

The village has already initiated this program as described in this report.

Monitoring of Water Quality

The 1986 amendments make two important changes to Section 1445 regarding monitoring for contaminants. First, the USEPA now considers system size and the type of contaminants that might be found when establishing a monitoring schedule. This procedure provides a much needed flexibility for smaller systems and for those with little potential for contamination by a broad range of chemicals. Second, the agency requires public water systems to monitor for unregulated volatile organic compounds (VOCs).

The NYSDOH requires public water systems to monitor the primary drinking water standards and, using their discretion, the NYSDOH may also require secondary drinking water standards to be monitored. Samples are collected from the point of use. The MCL and the monitoring and notification requirements for public water systems in New York State are described in Part 5 of the State Sanitary Code (see Appendix B of this report). A list of the regulated contaminants (primary and secondary) and their MCLs is provided in Table 1. The state can vary the monitoring schedule and frequency when it has reason to believe that the MCL has been violated or that the potential exists for an MCL violation.

Monitoring requirements for VOCs are described in an October 22, 1987 letter from the NYSDOH addressed to water suppliers; this letter is included in Appendix B. Since the Village of Croton-on-Hudson well field serves less than 10,000 persons, the monitoring requirements described in the letter should commence in 1989, instead of the 1988 date specified. A group of both regulated and unregulated must be monitored on a quarterly basis for 1 year, starting in 1989; the unregulated contaminants are listed in Table 2. Two VOCs (List 2 in Table 2) must be monitored only once during the year. Each supply well will need to be sampled, prior to mixing with other sources. Subsequent monitoring requirements will depend on the preliminary analytical results and will be at the discretion of the state.

Water-Quality Analyses

The most recent analysis of the village water supply was in August 1987 from Well No. 1 for parameters with primary and secondary drinking water standards. The results indicate that all concentrations are well below drinking water standards. The water contains no detectable pesticides, herbicides, or polychlorinated biphenyls (PCBs). A July 1987 sample taken from the distribution system and analyzed for volatile halogenated organic compounds (USEPA Methods 502/601 and volatile aromatic and unsaturated

ganic compounds (USEPA Methods 503/602) shows no indication of any water-quality problems.

DELINEATION OF THE ZONES OF PROTECTION

The delineation of protection zones around a well field is based on the hydrogeology and the topography of the surrounding area. Based on previous hydrogeologic studies ried out at the well field (Geraghty & Miller, Inc. 1970; 1977; 1978; 1988) and examination of topographic maps (USGS 1967;1979), Geraghty & Miller recommends establishment of the following three protection zones shown on Figure 1:

Wellhead Protection Area, Zone 1: This zone includes the area of the well field itself with a protective perimeter around each of the water-supply wells.

Aquifer Recharge Area, Zone 2: This zone consists of the valley floor immediately surrounding the well field that contributes recharge directly to aquifer.

Watershed Area, Zone 3: This zone consists of the uplands surrounding the aquifer recharge area that provide surface-water drainage to the aquifer recharge area and the well field.

A detailed discussion of the delineation, land use, and potential sources of contamination for each protection follows, and recommendations for protecting the water quality are also provided. Unless more stringent controls are specified, the restrictions described for Zone 2 will also pertain to Zone 1, and those for Zone 3 will pertain to Zone 2, where applicable. These recommendations incorporated in the proposed rules and regulations that presented as Appendix A to this report.

Zone 1 - Wellhead Protection Area

The wellhead protection area, designated Zone 1 in this report, lies within the Croton River Valley. It encompasses the well field and a protective buffer. The area compasses approximately 20 acres and is presently zoned as residential, with less than one dwelling unit per acre in a minimum lot area of betw 1 to 4 acres. However, no homes exist within the area.

Most of the land within Zone 1 is owned by the Village of Croton-on-Hudson Water Department, with the exception of an area in the northern portion of Zone 1 that is within the limits of the Town of Cortlandt. The Old Croton Trailway passes through Zone 1. The surficial geology of Zone 1 is predominantly unconsolidated sand and gravel deposits.

The aquifer underlying Zone 1 is recharged by the Croton River which originates from the overflow of the New York City reservoir water from New Croton Dam. In this report, Geraghty & Miller assumes that the water in the Croton Reservoir is clean and does not have to be considered as a potential contamination source.

Recommendations for Zone 1

All land within Zone 1 should be owned by the Village of Croton-on-Hudson Water Department in order to protect the wellheads. Only systems, facilities, and activities directly related to public supply should be allowed within the area. Unauthorized people and vehicles should be prohibited. The pumping facilities should be protected from damage, and trespassing signs should be prominantly displayed. No non-point sources of contamination such as septic systems or use of fertilizers, pesticides, herbicides, and halite, should be allowed in the wellhead protection area.

Surface water that can become contaminated with non-point sources, such as road salt or runoff, should be diverted from Zone 1 to an area downgradient of the well field. To prevent entrance of surface water into wells during flooding of the Croton River Valley, pumping wells should be elevated above flood levels and all observation wells should be tightly capped. The roads and an asphalt

berm located within Zone 1 should be maintained so that the spraying of protective chemicals or resurfacing will be unnecessary. If the roads should have to be resurfaced, it would be preferable to use a method that does not include hydrocarbons.

Zone 2 - Aquifer Recharge Area

The aquifer recharge area of the Croton River, designated Zone 2, includes areas of the valley floor upgradient, downgradient, and west of the wellhead protection area (Zone 1). The area downgradient of the well field is included in Zone 2 as an extra measure of protection during low-flow conditions in the Croton River when the cone of depression created by pumping will extend further downgradient than under normal flow conditions.

The recharge area is underlain by sand and gravel meltwater deposits, which allow for rapid infiltration of surface water and precipitation to the water table and into the ground water. The approximate total area of Zone 2 is 68 acres. The area located within the Town of Cortlandt is zoned as having less than one dwelling unit per acre in lots of between 1 to 4 acres, and the area within the Village of Croton-on-Hudson is zoned for one to two dwelling units per acre in lot areas of 1/2 to 1 acre. According to the 1980 census, less than 100 people live in Zone 2. The area contains private homes and two parks. A portion of the

Westchester County Croton Gorge Park, which has a total area of 97 acres (Westchester County, Open Space Map 1986), is located within Zone 2, south of the New Croton Dam. The Village of Croton-on-Hudson owns Black Rock, an unused park south of the well field.

Recommendations for Zone 2

The following facilities and activities should not be allowed in Zone 2: wastewater disposal wells, recharge basins, stockpiling of snow from urban areas, junkyards, animal and farm wastes, application of sludge, open fertilizer storage, and toxic chemicals. Toxic chemical transport should be prohibited, except under permit. Fertilizer use should be controlled by the Soil and Water Conservation District's best management practices. Herbicides and pesticides should not be allowed without first performing an environmental assessment. The use of halite for deicing should be restricted to the minimum amount needed for public safety and, whenever possible, calcium chloride should be used instead of halite. Ground-water quality downgradient of the septic systems in close proximity to the well field should be monitored, specifically for nitrates and chlorides. Any sewer systems that may be installed in the future should be checked and maintained so that no leakage occurs. If a potential for ground-water contamination from the sewers is likely, a ground-water quality monitoring program should be established.

Croton Gorge Park should be required to maintain safe environmental practices that preserve the ground-water quality within the aquifer. Since it is located in an environmentally sensitive area, a dialogue should be initiated with Westchester County to inform the county about the proposed regulations. The park has a toilet building, which draws well water and uses a septic system with a leaching field. The system should continue to be maintained in good working order, which should include pumping out the septic tank as necessary. According to park authorities, no fertilizers are used at the park, and use of fertilizers should be restricted in the future. Pesticides have only been used during emergencies, such as the gypsy moth invasion; in the future, an environmental assessment should be performed before pesticides and herbicides are sprayed. The practice of deicing the roads in the parks by using small amounts of halite lightly mixed with sand may be continued.

Croton Gorge Park is not locked at night to facilitate patrol by the Westchester police and to provide access to a private residence, which predates the park. The residence is located at the southern end of the park. Because of the proximity to the well field, this situation of an unlocked park should be addressed. Reportedly, there has been some sporadic dumping of refrigerators or other appliances in the park. The park should be patroled by the police on a more

frequent basis, and it may also be prudent to lock the park at night to deter illegal dumping. Perhaps another road could be constructed to the private residence or, if such construction is not feasible, residents could be given the key to the park gate.

Included in Zone 2 is a portion of Croton Dam Road, which is a narrow road that is scheduled for resurfacing in the near future. During the resurfacing, care should be taken so that no contaminants are introduced to the soil or the surface water. This road requires extensive salting during the winter because it freezes easily; however, the application of halite should be kept to a minimum and sand or calcium chloride should be used whenever possible.

Zone 3 - Watershed Area

The watershed area tributary to the recharge area (Zone 3) is the largest zone, comprising approximately 720 acres. This zone is the upland area of the watershed that provides surface drainage to the well-field aquifer. The underlying bedrock consists of the Inwood Marble and Manhattan Schist formations. The surficial glacial geology of Zone 3 consists mostly of sheets of sandy till of varying thicknesses. Surface water and precipitation in the area travel down tributaries of the Croton River or overland toward the valley. The water which reaches the valley and infiltrates the soil recharges the aquifer

In 1980, approximately 850 people lived in the watershed area (Westchester County 1981). The area within the Town of Cortlandt has several zoning designations. A small section is zoned as commercial campus-type office research and as an industrial park. Most of the residential area within the Town of Cortlandt is zoned as less than one dwelling unit per acre with a minimum lot area of 1 to 4 acres. In addition, there are two smaller areas designated one to two dwelling units (minimum lot area of 1/2 to 1 acre) and two to nine dwelling units (minimum lot area from 4,900 ft^2 to 20,000 ft^2). Within the Village of Croton-on-Hudson, most of the area is zoned as residential with one to two dwelling units per acre with a minimum lot area of 1/2 to 1 acre and one small section with a zoning description of 9 to 16 dwelling units per acre with a minimum lot area from 2,720 ft^2 to 4,800 ft^2.

Recommendations for Zone 3

Septic systems constitute the largest non-point source of contamination as approximately three-quarters of the population use septic systems instead of sewers (Figure 3). No portion of any septic system should be constructed, placed, or rebuilt within 50 ft of Zone 2 (the recharge area) or of any surface-water course in the protection area. Existing septic systems located within 50 ft of a recharge area or surface-water course should be monitored by a

carefully placed ground-water monitoring well network. Septic systems must be maintained in good operating order and must be properly installed. If necessary, a sewage maintenance district should be set up in the Town of Cortlandt and the Village of Croton-on-Hudson to maintain, install, and pump the septic systems. Educational pamphlets about septic system maintenance and what is permitted to be disposed of in an on-site system should be distributed periodically. There are several homes along Route 129 that are adjacent to Zones 1 and 2. Consideration should be given to extending the sewer system to include these homes, or at least the ones adjacent to Zone 1.

The small area in Zone 3 that has sewers should be checked periodically for the amount of leakage. The application of halite should be minimized and snow should not be dumped into streams within the watershed area. Surface runoff routes should be checked by both the Town of Cortlandt and the Village of Croton-on-Hudson to ensure that no potentially contaminated runoff channels into Zone 1. Animal wastes should be properly disposed of, away from any water course. A minimum of fertilizer should be used, and it should be applied according to the best management practices developed by the State Soil and Water Conservation District. Herbicides and pesticides should also be used sparingly and under permit as required in Environmental Conservation Law, Article 33.

The possibility of leaks from underground petroleum storage tanks needs to be carefully addressed. Two commercial properties that may have large-volume fuel oil storage tanks have been identified within the watershed: the Danish Home for the Aged and the W.D. Contracting Building. Their locations are shown on Figure 3. Other commercial properties located a short distance outside the watershed area are a bus garage, a towing service, and a transmission repair shop. Their locations are also shown on Figure 3. However, because these properties are located outside the watershed, any contaminants associated with these sites would not be expected to affect the well field.

Commercial properties within the watershed should be checked for the existence of tanks storing fuel or other potentially hazardous material. All underground fuel storage tanks located within 500 ft of Zone 1 should be inventoried. The location, size, type, age, contents, and overall condition of the tanks should be determined and included in the inventory. All unprotected underground tanks, such as bare-steel or painted-steel tanks, should be tested for leaks when they are 10 years old and then every 5 years thereafter. New petroleum storage tanks that are regulated under their storage capacity must be constructed, installed, and monitored in accordance with the New York State Petroleum Bulk Storage regulations (NYSDEC 1985). It is recommended

that new, smaller capacity petroleum storage tanks that are not regulated have at least corrosion-resistant tanks and piping, and, if possible, secondary containment. If the potential for ground-water contamination seems likely, a ground-water quality monitoring program should be established.

Spills along Route 129 and other roads in the watershed are an important concern. Route 129 is rated by Westchester County to be a road which has less than 10,000 vehicles a day traveling on it; this rate is low compared to other routes in the county. However, because of the proximity of Route 129 to the well field, the consequences of a spill are serious. An emergency response network for this particular type of accident should be formed.

The fire department or the police department in both the Town of Cortlandt and the Village of Croton-on-Hudson should be trained in spill remediation and cleanup procedures, and equipment should be stockpiled. Sorbant booms, strips, blankets, sawdust, miscellaneous tools (such as shovels, axes, and rope), and other equipment should all be stored in an accessible area in case of an emergency.

In the event of a spill, the containment effort and equipment should be concentrated far enough below the front edge of the spill to ensure ample time for installing the

containment and retrieval equipment. The containment effort should also be organized so that the pollutant is contained to the smallest possible area to facilitate containment and to minimize damage to the surroundings. Techniques such as sand bagging, construction of earth-filled dams, and straw barriers can all be used to contain the potential ground-water and surface-water contamination.

A drainage system should be constructed as soon as possible to divert a spill and potentially contaminated runoff from the well field. An asphalt or concrete berm should be constructed along the eastern edge of Route 129, north of and adjacent to the well field, in order to divert the overland flow. Also, a ditch should be constructed between the berm and the road so that it leads to a point at least 100 ft downgradient from the well field and drains into a dry well. This ditch would carry the spilled liquid or runoff away from the environmentally sensitive area to an area where its impact will not be as severe.

Another non-point source of ground-water contamination is hazardous consumer products, such as automobile oil, that are added to septic systems or washed down catch basins. This issue should be targeted in a public educational campaign. Collection days should be implemented for hazardous household materials.

In general, within the proposed regulation, Zone 2 has similar or stricter regulations than Zone 3. The primary concern of this study is that the water courses and valleys in Zone 3 remain as clean as possible.

CONCLUSIONS

1. A three-tiered prioritized land-use system has been set up by this study and it follows the accompanying proposed regulations. According to the New York State guidelines, the three protection zones are defined as the wellhead protection zone, the aquifer recharge zone, and the watershed area.

2. Most of the protection area is within the Town of Cortlandt.

3. Non-point sources constitute the potential contaminants to the Croton River aquifer. These sources include septic systems, sewers, road salt, storm-water runoff, animal waste, fertilizers, herbicides, pesticides, leaking underground petroleum storage tanks, and spills.

4. Proposed regulations based on this report and on the New York State Department of Health regulations are included as Appendix A; they should be reviewed and

modified, as needed. These regulations would put into law many of the issues discussed in this report, and they will supplant the 1960 Rules and Regulations for the Protection from Contamination of the Public Water Supply of the Village of Croton-on-Hudson, Westchester County, New York.

RECOMMENDATIONS

1. Dialogue should be established between the Village of Croton-on-Hudson and the Town of Cortlandt regarding the proposed water supply protection measures, and the village and the town should jointly enact appropriate regulations.

2. The wellhead protection zone, the aquifer zone, and the watershed area, as shown in Figure 1, should be so designated by the Village of Croton-on-Hudson and the Town of Cortlandt.

3. Zoning designations within the protection areas should be reviewed.

4. A ground-water monitoring program should be established to monitor water quality downgradient from septic systems located near Zone 1.

5. Residents of the protection area should be fully informed of the new regulations and educated about how they can help prevent ground-water contamination. The subjects of the educational campaign should be as follows: use of pesticides, herbicides, and fertilizers; septic maintenance; and the proper disposal of animal wastes and consumer products.

6. Prevention of spills along Route 129 should be a primary goal of the village. In coordination with the Town of Cortlandt, a berm and ditch system should be constructed along the section of Route 129 that parallels the well field. Emergency equipment and supplies should also be stockpiled, and personnel should be trained for emergency response in case of a spill

7. An application for sole-source aquifer classification should be made to the USEPA. Presently the state considers the Croton aquifer to be a primary aquifer.

8. The industrial area and commercial properties within the watershed should be field checked for fuel storage tanks and other potential contaminants. An inventory should be made of all underground fuel storage tanks located within 500 ft of Zone 1. The location, size, type, age, contents, and overall condition of the tanks

should be determined and recorded. Ground-water monitoring should be performed where the potential for contamination seems likely. Underground pipe lines should be limited within the protection area.

9. The existing sewers within the protection area should be checked for leakage. Ground-water monitoring should be performed where the potential for contamination seems likely. Consideration should be given to installing sewers for the residences located along Route 129 adjacent to the well field.

10. A septic maintenance district should be set up for the protection area.

11. A program involving the collection of hazardous materials from households within the protection area should be performed in conjunction with the Westchester County hazardous waste collection day.

12. The village should purchase land to include all of Zone 1 and additional area within Zone 2.

Respectfully submitted,

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LCR/CLG/FvdL:vk
January 12, 1989

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Table 1. Regulated Contaminants

Inorganics	Maximum Contaminant Level
Arsenic	0.05 mg/L
Barium	1.
Cadmium	0.010
Chromium	0.05
Fluoride	2.2
Lead	0.05
Mercury	0.002
Nitrate	10.
Selenium	0.01
Silver	0.05
Chloride	250.
Copper	1.
Corrosivity	Noncorrosive
Iron	0.3
Manganese	0.3
Sodium	No designated limits
Sulfate	250.
Zinc	5.
Color	15 units
Odor	3 units
Organics	
Endrin	0.0002 mg/L
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01
Total trihalomethanes	0.10
Volatile Organics	
Trichloroethylene	5. ug/L
Carbon tetrachloride	5.
Vinyl chloride	2.
1,1,1-Trichloroethane	200.
1-2-Dichloroethane	5.
Benzene	5.
1,1-Dichloroethene	7.
Para-dichlorobenzene	75.
Physical	
Turbidity	1 TU monthly average 5 TU average of two consecutive days

Table 1. Regulated Contaminants

Microbiological	Maximum Contaminant Level
Coliform bacteria	1 per 100 ml monthly average
	4 per 100 ml in more than one sample
Radionuclides	
Combined Radium 226 & 228	5 pCi/L
Gross alpha	15 pCi/L
Man-made beta	4 millirems/yr

Source	New York State Sanitary Code, Part 5.
mg/L	Milligrams per liter.
ug/L	Micrograms per liter.
TU	Turbidity unit.
ml	Milliliters.
pCi/L	PicoCuries per liter.

Table 2. Unregulated Contaminants

List 1 Monitoring Required for All Systems	List 2 Monitoring Required for Vulnerable Systems	List 3 Monitoring Required at the State's Discretion
Bromobenzene	Ethylene dibromide (EDB)	Bromochloromethane
Bromodichloromethane	Dibromochloropropane (DBCP)	n-Butylbenzene
Bromoform		Dichlorodifluoromethane
Bromomethane		Fluorotrichloromethane
Chlorobenzene		Hexachlorobutadiene
Chlorodibromomethane		Isopropylbenzene
Chloroethane		p-Isopropyltoluene
Chloroform		Naphthalene
Chloromethane		n-Propylbenzene
o-Chlorotoluene		sec-Butylbenzene
p-Chlorotoluene		tert-Butylbenzene
Dibromomethane		1,2,3-Trichlorobenzene
m-Dichlorobenzene		1,2,4-Trichlorobenzene
o-Dichlorobenzene		1,2,4-Trimethylbenzene
trans-1,2-Dichloroethylene		1,3,5-Trimethylbenzene
cis-1,2-Dichloroethylene		
Dichloromethane		
1,1-Dichloroethane		
1,1-Dichloropropene		
1,2-Dichloropropane		
1,3-Dichloropropane		
1,3-Dichloropropene		
2,2-Dichloropropane		
Ethylbenzene		
Styrene		
1,1,2-Trichloroethane		
1,1,1,2-Tetrachloroethane		
1,1,2,2-Tetrachloroethane		
Tetrachloroethylene		
1,2,3-Trichloropropane		
Toluene		
p-Xylene		
o-Xylene		
m-Xylene		

Source Fed. Reg. 52:130 (July 8, 1987)

Aquifer Protection Plan Croton-on-Hudson Well Field, Exhibit 9 to the Amicus Brief of the Village of Croton-on-Hudson, contains four large maps. For more information about these maps please send an email inquiry to gcos.inquires@noaa.gov.