Report

Chemung River Valley Water Study

Town of Erwin, Town of Corning, City of Corning, Village of Painted Post, and Village of Riverside, New York

September 2002

Stearns & Wheler
Companies

CHEMUNG RIVER VALLEY WATER STUDY

TOWN OF ERWIN, TOWN OF CORNING, CITY OF CORNING, VILLAGE OF PAINTED POST, AND VILLAGE OF RIVERSIDE, NEW YORK

Prepared for

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Since the start of the area's most recent drought (1999), the municipalities involved in the Chemung River Valley Water Study have met regularly to discuss drought-related issues. These regular meetings have also provided an opportunity for each of the communities to better understand the water needs and concerns of their neighbors.

In the late 1990s, industrial production in the valley was at peak and additional growth was anticipated. Due to this growth, and the fact that the 1990s had experienced two extended dry periods (1991 and 1999), the communities recognized that a better understanding of the valley's ability to support growth from a water supply perspective was needed. The communities involved in this study (Towns of Erwin and Corning, City of Corning, and the Villages of Painted Post and Riverside), together with the New York State Department of Health and the Southern Tier Central Regional Planning and Development Board (STCRPDB), formed a Steering Committee to investigate and guide the valley communities in their joint efforts to maintain a high level of water service to their customers.

Through these meetings, which originally revolved around drought management planning, the Steering Committee developed a list of water issues that required investigation. The major issues included:

1. The need for a regional Drought Management Plan that would permit the communities to act in unison to implement water use restrictions when such action was appropriate. The drought triggers (levels of precipitation or river stage that activate an action plan) needed to be identified and the action plan developed.

2. The establishment of a "safe yield" for the Corning area aquifer. What yield can the study area support?

3. The determination of whether an alternate joint administrative structure could result in more efficient and effective water service to the customers in the Chemung River Valley. Recognizing that each community currently owns and operates its own independent system, the Steering Committee requested an evaluation of alternate management structures that might take advantage of economies of scale.

4. Evaluation of whether joint purchase of major equipment and supplies could result in appreciable savings in operation and maintenance costs to the individual communities.

These issues were used to formulate the tasks for the Chemung River Valley Water Study.

Stearns & Wheler/Leggette, Brashears and Graham proposed to utilize an existing groundwater model of the Corning area aquifer (CAAM88) to develop the maximum sustainable yield and several other miscellaneous items of concern. This model was developed by the Susquehanna River Basin Commission (SRBC) in 1988 (Ballaron, 1988). The scope of services for this water study called for the existing model to be used (as calibrated in 1988) to predict future conditions (yield, groundwater flow direction, and potential location of monitoring wells). After an extensive period of attempting to locate a working copy (electronic copy) and/or a written copy (computer code with all data files) of the model, it was concluded that the model and those files were no longer available. Neither the SRBC nor the United States Geological Survey (USGS) had retained copies, since their computer systems had been completely revised over the past 12 years. Since the model is critical for the prediction of future water needs within the valley, it was decided to redevelop the model, recognizing that the effort would utilize budget originally slated for other tasks. Chapters 6 and 7 review the modeling effort and predictive information developed from the re-established model. It was agreed that the Steering Committee would be provided with a list of data gaps and model shortcomings that would require future effort beyond the scope of this study.

Initially, there was disagreement within the Steering Committee on the relative importance of the various tasks within the study. It was agreed early in the investigation that the effort in evaluating administrative structures should be expanded. To accommodate this expansion, which includes budget analysis and development of an annual budget for the recommended administrative structure, the following tasks were deleted:

1. Subtask 3C - Identification of future well site (entirely deleted).

2. Subtask 3D - Designation of monitoring well sites. Time of travel analysis was eliminated from this task.

The Chemung River Valley Water Study was started in August 2001 and scheduled for completion in March 2002; however, the difficulty in data gathering and the lack of availability of the CAAM88 necessitated an extension to September 2002. Prior to starting the investigation, the project was chartered with the consultants, municipalities, health department, and planning agency. Chartering is a technique used to define and build a project team such that the project scope and expectations of the team are established upfront. In addition, chartering established the following:

1. Identified decision-makers (municipalities).
2. Decision-making process (consensus was selected as the appropriate mechanism).
3. Critical success factors were identified.
4. Established the project mission statement.

The mission statement developed by the team through the chartering process was:

> "Provide the Chemung River Valley Water Study Committee an action plan to enable that Committee to achieve their mission of source protection and improve cost-effectiveness now and in the future."

The Critical Success Factors (CSFs) developed by the team were:

1. What is the best way to provide water to customers in the valley, now and in the future.

2. Provide supporting data and documentation to support cost-effectiveness.

3. Describe and analyze administrative options. Present advantages and disadvantages for the various options.

4. Provide recommendations.

5. Provide regulatory guidance for an aquifer protection/drought management plan.

This study achieved most of the points in the mission statement and CSFs, with the exception of establishing the final plan for aquifer protection. Because of the greater emphasis placed on the alternate administrative structures and the need to redevelop the groundwater model, the source protection tasks were deleted. However, the re-established groundwater model provides the initial framework for modeling of source protection issues.

Throughout the year, monthly meetings with the project team (municipalities, Stearns & Wheler, and interested parties, such as NYSDOH, STCRPDB, and SRBC) were held to review data and progress, identify data needs, and decide on recommended alternatives and future courses of action.

CHAPTER 2

POPULATION AND WATER USE

2.1 INTRODUCTION

Into the 1970s, the Chemung River Valley, including the City of Corning and its immediate proximity, experienced steady increases in population. The most substantial population changes occurred during the 1950s and 1960s. However, since the 1970s, the area, with the exception of the Town of Erwin, has seen a gradual decrease in population. The Town of Erwin has continued to experience an increase in population, although at a slower rate than during the years prior to 1970. The Chemung River Valley area, in general, has mirrored the relatively static population of Steuben County.

Future populations are expected to decline or remain constant due to changes in the economy for most of the Chemung River Valley. Future and existing population projections were established for the study area, i.e., Town of Erwin, Town of Corning, City of Corning, Village of Painted Post, and Village of Riverside using the responses to Questionnaire No. 3 (Stearns & Wheler, 2001), master plans (S.I. Brown Assoc., 1993; Hunt Eng., 2002), and available demographic analyses (Claritas, 2001; STCRPDB, June 2002) for those communities. Future water demand projections for the study area as a whole were then calculated using those individual population projections and estimates of per capita water use.

The projections are based on a 10-year time frame. Even though this time frame is relatively short, uncertainties associated with the projections remain. Currently, because of the decline of the economy, industry in the Chemung River Valley has recently seen an abrupt decrease in production and staff sizes. This decline has the potential to affect the population of the valley. Population projections made a few years ago are already outdated because of this unexpected economic decline. It should be noted that the projections used for this study were based on current conditions; however, there is the potential for industrial recovery when the economy rebounds.

2.2 POPULATION AND WATER USE PROJECTIONS

Table 2-1 shows the current number of customers and water production for the various service areas in the valley. The information contained in the table is based on information obtained from and confirmed with the communities involved. The Village of Riverside does not produce any water, but buys water from the Village of Painted Post. Their usage was reflected in the water production for the Village of Painted Post.

TABLE 2-1

CURRENT WATER USE AND SERVICE AREA [1]

	Water Production (mgd)		Service Area	
	Average Day	Maximum Day	Customers	Population
Town of Erwin	0.40	0.70	1,100	3,500
Village of Painted Post	0.44	0.58	800	1,840
Village of Riverside	[2]	[2]	230	590
Town of Corning	0.08	0.11	300	2,800 [3]
City of Corning	2.18	3.00	4,100	10,840
Total	**3.10**	**4.39**	**6,530**	**19,570**

[1] *Data developed based on information provided by the various communities in late 2001. Sources include municipal responses to various questionnaires developed by Stearns & Wheler, available demographic analyses, master plans, and on water production records.*

[2] *Included in Village of Painted Post's production.*

[3] *Includes Corning Community College.*

Future water use projections were made based on population projections that the communities have made and incorporated into their master plans. All communities show a decline in population, except for the Town of Erwin. This population decline directly affects the amount of water used and the needed production from the Chemung River Valley aquifer. Fewer people (and potentially less industrial activity) will use less water; therefore, the communities will not have to produce and treat as much water to meet the needs of the population.

Current and projected water use values, as shown, are expected to remain approximately equal throughout the study period. Over the next 10 years, water use is expected to increase only slightly. This is due to the relatively minor change in population projected over that time period (see Table 2-2).

TABLE 2-2

WATER SERVICE AREA
CURRENT AND PROJECTED POPULATION

	Current	Projected (2012)
Town of Erwin	3,500	4,850
Town of Corning	2,800 (1)	2,840 (1)
City of Corning	10,840	9,900
Village of Painted Post	1,840	1,740
Village of Riverside	590	590
Village of South Corning	1,150	1,300

(1) *Includes Corning Community College*

Table 2-3 shows current and projected average and maximum day water production for the communities in the study area. The Village of South Corning was included in this table (even through they did not participate in this study) because they draw from the same aquifer and their water use impacts the communities included in the study. This overall water use was then used in determining the adequacy of the aquifer (see Chapter 7). The production data is based on available well information for the past four years.

TABLE 2-3

CURRENT AND PROJECTED MUNICIPAL WATER USE

	Current (mgd)		Projected (mgd) [1]	
	Average	Maximum	Average	Maximum
Town of Erwin	0.40	0.70	0.58	0.97
City of Corning	2.18	3.00	2.00	2.90
Town of Corning	0.08	0.11	0.08	0.12
Village of Riverside	(2)	(2)	(2)	(2)
Village of Painted Post	0.44	0.58	0.42	0.54
Village of South Corning	0.14	0.16	0.16	0.20
Total	**3.24**	**4.55**	**3.24**	**4.57**

[1] *Projected to 2012 based on population trends and per capita consumption.*
[2] *Included in the Village of Painted Post's water use.*

In addition to the municipal water use, the major industrial complexes utilize their own wells for some process, but primarily for non-contact cooling purposes. This non-contact cooling water is withdrawn from the aquifer and returned to the Chemung River system in close proximity to the particular industrial site. Since many of the industrial wells are unmetered, the daily withdrawal rates have been estimated by the individual manufacturing facilities based on pump capacity/run time of pumps or from SPDES permit waste discharge information. Table 2-4 summarizes the aquifer withdrawal by the major manufacturing facilities in the study area. In general, maximum daily records for industrial cooling water use are not available; therefore, a typical peaking factor of 1.5 was used to estimate maximum daily withdrawal for industrial cooling and process uses. Therefore, the current average and estimated maximum daily industrial uses are 3.6 and 5.4 mgd, respectively. Allowing for a 10 percent increase over the next 10 years, the 2012 industrial uses are estimated to be 4.0 and 6.0 mgd, respectively, for the average and maximum daily withdrawal.

TABLE 2-4

CURRENT INDUSTRIAL WATER USE
INDUSTRIAL WELL PRODUCTION

Industry	Current Average Daily Withdrawal (mgd)
Corning, Inc.	
Headquarters	0.7
Houghton Park	0.7
Sullivan Park	0.6
Dresser-Rand	0.1
Erwin Manufacturing	0.4
World Kitchen, Inc.	1.1
Total	**3.6**

* *Total well capacity is 9.3 mgd; however, much of this capacity is reserve. Maximum daily flow estimated based on a 1.5:1 ratio of maximum daily to average daily flow.*

Based on the current and projected aquifer withdrawal estimates, the long-term municipal and industrial withdrawals (average daily) are 6.8 and 7.2 mgd, respectively.

2.3 AREAS OF GROWTH

Currently, Corning, Inc., World Kitchen, Dresser Rand, and Pollio all have significant operations in the valley. Because of the recent economic downturn, production in these companies has remained constant or declined. This has led to a reduction of staffing required at these facilities, which has begun to impact the population of the valley, as previously discussed. If the economic decline continues, the population loss could escalate as workers with specialized job skills are forced to relocate. On the positive side, the valley is fortunate to have a number of well-established employers that offer diverse opportunities for employment.

The intent of this section is not to predict future economic behavior, but to identify locations with the potential to handle future industrial, commercial, and/or residential growth.

A. **Village of Riverside.** The Village of Riverside is limited in terms of residential and industrial growth potential. The Village is predominantly residential, bordering the City of

Corning, the Village of Painted Post, and the Chemung River. Most of the village's potential for expansion has been exhausted since it is restricted by its borders. The same applies for industrial growth. Within the village, there are only limited areas that are currently undeveloped. There is the potential for commercial development in the vicinity of the existing exit ramp from the future I-86; however, if this development occurs, it is not expected to dramatically affect water use.

B. **Village of Painted Post.** The Village of Painted Post has the groundwater capacity in place to promote growth and development, but like the Village of Riverside, the Village of Painted Post is restricted by its borders. The village borders the Town of Erwin, the Chemung River, and the Village of Riverside. Growth area is restricted by the river, the highway system, and the hillside to the east. Like Riverside, much of the village's potential for residential growth within its borders has been exhausted. To accommodate industrial growth, Dresser-Rand, which operates a manufacturing facility in Painted Post, has land available that is zoned for industrial uses.

C. **Town of Corning.** The Gibson and the Corning Manor Water Districts (located along north side of river) both have the well capacity to support minor residential growth. Industrial growth could be accommodated; however, the type of industry allowed would be restricted to those with small water needs. There is limited area within these two districts for growth. Pinewood Acres (located on the highland south of the Chemung River) is the most likely area for residential growth, since it is a desirable "suburban" location away from commercial/industrial activity along the valley floor. The town buys water to supply this district from the Village of South Corning.

D. **City of Corning.** The City of Corning has the excess well capacity to support both residential and industrial growth. Corning Inc. and World Kitchen both have plants within the city that draw production and cooling water from their own well supplies. However, because of recent economic conditions, these industries have cut back on production and staff. These areas have the potential to rebound and be returned to full production by Corning Inc. and World Kitchen or to be developed by other companies.

E. **Town of Erwin.** Of the Chemung River Valley communities, the Town of Erwin has the greatest potential to promote industrial and residential growth within its borders. There is land available for development that has access to the Town's municipal water system. However, Erwin may not have the existing well capacity available to support full development of the

available parcels. Although there is the potential for growth within the Town because of the sprawling area available and the easy access to transportation routes, the extent of development depends on the capacity of individual wells. Depending on the magnitude of the growth, new wells may be required. The existing wells have the capacity to meet the Town's use projections for 2012 (see Table 2-2).

Specific areas for growth include the Industrial Park and the areas between Gang Mills and the Industrial Park. The plan to interconnect the Morningside Heights Water District (Gang Mills area) and the Industrial Park Water District will promote growth along the Route 417 corridor and along the north side of the valley in the Jones Road area (north of railroad and south of Forest Road). The Tioga River corridor is currently slated for construction of a new high school.

Plans have been completed to extend water main from the Morningside Heights Water District across the Cohocton River to serve the area of the Town immediately northwest of the Village of Painted Post. The extension of water across the river provides an opportunity to interconnect the Erwin and Painted Post systems in the future.

CHAPTER 3

EXISTING WATER SYSTEMS

3.1 INTRODUCTION

All of the communities located within the study area are fortunate to have sufficient to abundant groundwater supplies. These supplies are fed primarily from river recharge, although some of the yield is contributed by upland precipitation and stream flow. The river recharge is important since it enables the sources to produce even during extended dry periods. Aquifer yield and recharge are discussed in Chapters 6 and 7.

An additional advantage of a prolific, good quality groundwater supply is that limited treatment of the supplies is required. All of the wells require disinfection. Erwin and Painted Post use corrosion inhibitors/sequestering agents to isolate iron and manganese and to minimize corrosion. All of the treatment techniques are low cost and are the primary reason that water production costs within the valley are low.

The lower service zones of each water district are located along the river in a relatively flat section. As a result of the terrain, the hydraulic grade in most of the districts is similar, and service between adjacent communities can be accomplished with little pumping. The main obstacle to interconnecting adjacent water districts is the barriers created by the various rivers and the network of highways. Crossing these barriers can make the interconnections costly.

The next sections identify the major sources of supply and storage components of the various water systems. Each section refers to Figure 3-1, which is a map of the study area showing water supply sources (both municipal and industrial) and system storage.

3.2 TOWN OF ERWIN

The Town of Erwin is divided into two water service districts -- Morningside Heights Water District and the Industrial Park Water District -- to serve approximately 1,100 residential and industrial customers. Much of the distribution and treatment system in the Town is relatively new.

The Industrial Park is located in the southwest portion of the Town and serves various industrial users located along Route 417. As shown on Figure 3-1, the Industrial Park's water system consists of a 0.75 million gallon storage tank and a 250 gpm well and pumping station. The distribution system primarily consists of 10-inch water mains.

The Morningside Heights water system serves mainly residential and commercial customers located in the Gang Mills area of the Town of Erwin. The Morningside Heights Water District also serves potable water to Corning, Inc.'s Sullivan Park complex. There are three wells and pumping stations that provide water to the Morningside Heights water system, located on Figure 3-1 as Well Nos. 2, 3, and 4. Wells Nos. 2 and 3 each have a capacity of 0.58 mgd; Well No. 4 has an approximate capacity of 1.1 mgd. Well No. 4 also has an emergency generator that provides standby power for the pump station. All three wells are treated with chlorine, fluoride, and a corrosion inhibitor before distribution.

Four water storage tanks are used to serve areas of different pressure in the Morningside Heights district. All four tanks are located on Figure 3-1. The three wells pump to a 1.0 million gallon storage tank. This tank provides water to the low-lying areas along the valley floor. The other three tanks (a 0.15 mg storage tank, a 0.10 mg storage tank, and a 1.5 mg storage tank) service the various high service areas of the system.

3.3 VILLAGE OF PAINTED POST

The Village of Painted Post's water system consists of three wells and two storage tanks to serve approximately 1,000 customers, both in the Village of Painted Post and the Village of Riverside. The Painted Post wells and storage tanks are numbered and labeled on Figure 3-1 as Well Nos. 1, 2, 3, and 4. Well No. 1, as shown, is an abandoned well. Well No. 2 has an approximate capacity of 0.58 mgd and is used only as a standby source of water. Well No. 3, with a capacity of 0.73 mgd, and Well No. 4, with a capacity of 1.5 mgd, are the main sources of supply for the village's water system. All three wells are treated with chlorine, fluoride, and a corrosion inhibitor before distribution. The corrosion inhibitor is used to sequester elevated levels of manganese found in the well supplies. Most of the Village of Painted Post's distribution system is approximately 100 years old. The majority of the distribution system consists of 6-inch diameter pipe.

The Village of Painted Post has two water storage tanks (a 1.5 million gallon prestressed concrete reservoir and a 50,000-gallon standpipe) to serve the various areas of the community.

The Village of Riverside purchases water from the Village of Painted Post through an 8-inch metered connection on East High Street in the Village of Riverside.

3.4 VILLAGE OF RIVERSIDE

The Village of Riverside buys water from the neighboring Village of Painted Post in order to supply water to its 230 customers. Because the water purchased from Painted Post is properly treated, it is not necessary for Riverside to provide any additional treatment. The water is delivered by gravity (no additional pumping is required) from the Painted Post system.

As previously mentioned, the Village of Riverside draws water from the Village of Painted Post through an 8-inch metered connection at East High Street in the Village of Riverside. The Village of Riverside is also connected to the City of Corning's water system at Freeman Street near the village/city border. This connection is for emergency purposes only and is not currently operable; this connection will require rehabilitation in order to be considered reliable. The interconnection has never been operated.

3.5 TOWN OF CORNING

The Town of Corning owns and operates three water districts -- Gibson, Corning Manor, and Pinewood Acres -- which supply water to approximately 300 customers.

The smallest of the three districts is Corning Manor. The Corning Manor Water District mainly serves the Corning Country Club, Corning Manor, and some residential customers in the immediate area. There are two wells in Corning Manor that produce about 0.03 million gallons of water per day, combined. The water from the wells is pumped to a 42,000-gallon bolted steel water storage tank; this tank is less than 15 years old. Water is treated with sodium hypochlorite to provide bacterial disinfection before distribution.

The Gibson Water District has one well that produces approximately 0.26 mgd. The water is pumped to a 115,000-gallon water storage tank and is treated with sodium hypochlorite to provide bacterial disinfection before distribution. Within the last year, the majority of the piping

in the Gibson Water District has been replaced with new 8-inch pipe. A new 158,000-gallon bolted steel tank has also been added to the Gibson system.

The Town of Corning purchases water from the Village of South Corning to serve the Pinewood Acres Water District. Water is pumped from the village to a 315,000-gallon water storage tank. Water is treated with chlorine before distribution. The main water user of this district is Corning Community College.

3.6 CITY OF CORNING

The City of Corning has nine wells, as shown on Figure 3-1. Well Nos. 4, 5, and 6 are abandoned; Well Nos. 1, 2, and 9 are the main source of supply; and the remaining wells (3 and 8A) are used to supplement supply. Well Nos. 1 and 8A are equipped with air strippers to remove volatile organic contaminants. The City chlorinates all of its supplies for bacteria disinfection.

The City utilizes three water storage tanks to serve various areas of the City: a 100,000-gallon, a 250,000-gallon, and a 2.3 million gallon tank. In addition, there is a 3 million gallon reservoir serving the City. All storage facilities are located along the valley wall south of the City.

Both the Village of South Corning and the Village of Riverside are connected to the City's 100-year old distribution system. The Village of Riverside's connection on Freeman Street is inoperable and would require rehabilitation before it could be activated. This interconnection has never been operated. The Village of South Corning's connection is near McMahon Avenue and Evergreen Drive in the City of Corning. These connections are for emergency purposes only.

CHAPTER 4

COLLECTIVE PROCUREMENT

4.1 INTRODUCTION

One of the major focuses of this investigation was to explore the operational and financial advantages, which can be achieved through cooperative ventures among the five participating water systems. Currently, each community operates on its own to procure chemicals, power, miscellaneous supplies, insurance, and professional services. However, there has been no sharing of information to determine if competitive rates or comparable services were being provided to the various communities. The first task was to gather information from each of the five participating communities (Towns of Erwin and Corning, City of Corning, and Villages of Painted Post and Riverside) on their annual consumption and expenditures for the items identified by the Steering Committee in the RFP. Those specific categories included:

- purchasing of utilities, supplies, and equipment (chemicals, power, distribution materials, vehicles, and construction equipment)

- current staffing of water department

- annual expenditure for contractual services (insurance, engineering, leak detection, and services pertaining to capital projects)

This data was gathered through responses to questionnaires, which attempted to gather information relative to the current operation and operational expenses of each of the five systems. Based on responses to Questionnaire No. 1 and the existing budget items, the focus of the financial task was directed at the major expense items, with the understanding that even large scale savings in small expense items probably would not be worth the effort of developing a mechanism to implement those cost savings. However, it was the understanding of the Steering Committee that the identification of large expense items that could benefit from economies of scale might result in savings of tens of thousands of dollars. If savings on this order could be realized, then it was felt that joint ventures or collective purchases might be attractive. Table 4-1 summarizes the existing budgets for the five water systems and shows where the major expenses

are incurred. Those items include: equipment purchase, personnel costs, power costs, and service contracts. The potential savings through joint efforts or cooperative procurement for these categories are explored in greater detail in this chapter.

4.2 PURCHASING

A. **Chemicals.** Of the five water systems participating in this project, four of those systems operate their own groundwater supplies and provide chemical treatment to the source water. The Towns of Erwin and Corning, the City of Corning, and the Village of Painted Post all chlorinate their well supplies to provide microbiological disinfection. Erwin and Painted Post also add fluoride and a corrosion inhibitor to sequester the iron and manganese in the water. Table 4-2 summarizes the chemical quantities used and the annual expenditure for those chemicals. The participating communities use less than 10,000 pounds per year of gas chlorine and less than 2,000 gallons or 2,000 pounds of liquid chlorine. Since the valley uses less than 12,000 pounds of chlorine per year and spends only $6,000 on chlorine, chlorine purchases do not have the potential for significant savings through joint procurement.

Painted Post and Erwin each spend an additional $4,300 per year on fluoride and corrosion inhibitors. Therefore, the total annual chemical expense for the water systems in the Chemung River Valley is less than $15,000 (budgeted amount is $21,000). A total chemical cost of $15,000 annually for all five water systems represents a minor expenditure and does not offer the opportunity for a significant savings from bulk purchases. If Corning, Erwin, and Painted Post could jointly purchase chlorine at the lower unit cost that the City pays, a total savings of less than $400 could be realized. This lower cost is a result of bulk deliveries and would require coordination of deliveries among the three communities. For the minimal savings, this bulk purchase would not be worth the increase administrative effort.

B. **Electrical Costs.** Since each of the water systems with their own sources pump groundwater from the valley floor to their respective water storage facilities located high above the valley, electrical costs represent one of the highest expenditures for these systems. Annually, the four water systems spend approximately $230,000 for electricity (Table 4-3). Several years ago, the communities within the valley formed a consortium through the County to jointly purchase power. Therefore, electricity is already purchased at a bulk rate through the consortium and greater savings through other arrangements is not believed possible at this time. However, the New York State Office of General Services (OGS) has been attempting to develop a state

contract for the purchase of electricity. This process has been in the planning stages for several years and is not yet in place. Municipalities should periodically consult the state list of contracts (web site www.ogs.state.ny.us/purchase/spg/lists/commodty.asp) under Electricity for updates on this program.

C. **Vehicles and Construction Equipment.** Each water department owns or co-owns vehicles and construction equipment to perform both operations and maintenance of their individual systems. Table 4-4 lists the vehicles and construction equipment owned by the five municipalities participating in the Chemung River Valley Water Study.

In general, each municipal water department owns operations vehicles for its sole use. Each department has either passenger cars or pickup trucks for the everyday operation of the water systems, and these vehicles are not shared with other municipal departments (i.e., sewer, highway, or public works). Since the water departments own a minimal number of vehicles (a total of 10 for the five departments), it is not envisioned that the number of vehicles could be reduced under the current municipal structure. However, if a central administrative structure (i.e., Regional Water Authority) were adopted, the number of vehicles could be reduced. It is estimated that the number of cars and trucks could be decreased from 10 to 6 with an authority type structure. This reduction in vehicles could save approximately $10,000 per year, based on an eight-year life of vehicles. Since each of the municipalities is eligible to purchase vehicles from the state contract, it is not possible for the municipalities to obtain lower prices on vehicles by purchasing collectively. The state contract takes advantage of bulk purchase to obtain low purchase prices for new vehicles. The state contract is accessible on line at www.ogs.state.ny.us/purchase/spg/lists/commodty.asp.

With the exception of the City of Corning, the municipalities share construction equipment within their public works related departments (water, sewer, and highway). This sharing maximizes the use of this expensive equipment within the community. This sharing also spreads the cost of the construction equipment over a larger base, and thereby, reduces each of the departmental budgets.

The City's infrastructure is of sufficient size that there is a steady workload for a water main repair and replacement crew. Consequently, the City's water department owns and maintains a significant amount of construction equipment. The City's equipment stock (Table 4-4) enables their water department to operate a self-sufficient construction crew for leak repair, repair of

water services, and main repair and replacement. Major projects are bid to private contractors when the workload exceeds the water department's capabilities.

Under the current administrative structure, it would be impossible to manage the day-to-day sharing of equipment among the five municipalities. Since each community manages its work orders independently, equipment would not necessarily be available when needed; therefore, scheduling of work crews would be very difficult. Logically, an individual water department's first loyalty would be to its municipality. As long as political pressure is wielded by the customers, each municipality will and should react to that pressure within their own community. Customers and politicians do not want to hear that their project is awaiting the return of equipment from the neighboring community. Chapter 5 discusses alternate administrative structures that would be more amenable to a centralized equipment pool.

D. **Miscellaneous Equipment.** Miscellaneous equipment, such as the City's meter testing bench and their shoring systems, could be made available to the other communities when not in use. Since work crews frequently do not have the flexibility of waiting until equipment is not in use, there may be times when the equipment is needed, but not available. If this arrangement is acceptable, individual pieces of equipment could be rented to interested municipal parties. This would require the City to maintain a billing and collection system for such purposes.

4.3 SHARING OF STAFF

Historically, in the water industry, each municipal purveyor of the water has retained its own staff to operate and maintain its system. While this is not the most efficient means of operating neighboring water systems, it does enable the municipality to retain complete control over this essential service. Since the 1960s, there has been greater emphasis placed on regionalization of water service in large metropolitan areas. Syracuse, Rochester, and Buffalo areas all have regional water authorities that serve the population center around the Cities. This regionalization permits the individual municipalities to take advantage of an expanded revenue base to acquire greater expertise, while controlling water rates. In more recent years, much smaller systems have also been regionalized. Water Authorities have been formed in less cosmopolitan areas, such as Cayuga County, Wayne County, and Livingston County. See Chapter 5 for discussion of alternative administrative structures.

Each of the five water purveyors participating in this study border each other and have similar water systems and operational needs. All systems use groundwater, have similar treatment requirements, and operate their own metered distribution system. Each system reads meters and bills customers on a quarterly basis. Due to the similar nature of the five systems, personnel in each system have similar expertise and there is a redundancy in the duties of those personnel. As shown in Table 4-5, the five municipalities participating in this study employ the equivalent of 15 full-time staff members (13 full-time and 7 part-time). There are five water treatment operators on staff, when three could provide the proper coverage if this system were regionalized. The 3.5 supervisors could be reduced to two, and the number of meter readers could also be reduced with a regional system. However, considering the independent responsibilities of the five municipal systems, this redundancy is necessary with the current non-regional administrative structure. Each municipal system has a public health and legal responsibility to their constituency. While cooperative efforts among the individual communities are possible, they are difficult to implement without changing the organizational structure. With an alternate administrative arrangement, it is envisioned that annual savings in labor and benefits of between $50,000 and $130,000 could be realized, depending on the structure adopted.

With the current administrative structure, it is critical that cooperative ventures are well defined both in scope and in remuneration. Joint ventures are best managed as short-term efforts. Each municipality must perceive immediate value and cost-effectiveness, and those measurables are easier to accept by politicians in short-term endeavors. In ventures that provide long-term service and rely on time for that service to be equitable to all parties, it is likely that some of those parties will become discontent when they do not see equal service immediately. Examples of possible long-term arrangements that are difficult to manage with the current administrative structure include coalitions for day to day maintenance of distribution systems (leak repair, water service and meter replacement, and main replacement). Invariably, a party or parties will perceive a lack of equitability because not enough work is being performed on their system in a given year and the arrangement will fail.

Staff training offers an opportunity for cooperation among the Chemung Valley communities. The five municipalities create a base that could support local seminars. In order to be financially cost-effective, there would need to be enough interest locally to financially support the retaining of an outside trainer. Training issues that apply to all water departments and that are essential to both workers and management revolve around safety. Possible safety seminars include confined space, trench safety, and employee right-to-know issues. Each department has employees that

require training in one or more of these areas. If there is enough interest locally, it is best to have the training performed locally. It is the employers responsibility to provide safety training and there is more of a guarantee that the training will be received and in a timely manner if it is offered on site.

Cooperative efforts in emergency situations are prevalent in the utility industry. The water industry in particular has supported their neighbors in time of crisis by lending materials and equipment and through the short-term loan of personnel. It is critical that neighboring water systems define the assistance that they can provide to each other during different types of emergencies. These potential cooperative services should be brain-stormed and documented (in writing) during non-crisis conditions. The rapport developed among the members of the Steering Committee for this study should form a nucleus for these planning sessions.

4.4 CONTRACTUAL SERVICES

Each of the five water purveyors rely on contractual services for:

- engineering
- leak detection
- insurance
- major capital projects
- well redevelopment
- tank painting

Whereas the sharing of staff works best for discrete well defined tasks, the contractual arrangements that are most conducive to cooperative efforts are more global. First, the candidate tasks must apply to all parties and be of concern or interest to those parties. An example of a joint contractual endeavor that was suited to cooperative funding was the development of the drought management plan for the Chemung River Valley. This project was of interest to all five parties, required regional input, and all parties benefited from the economy of scale. Regional issues offer the best opportunity for cooperation when it comes to contractual arrangements.

A. **Engineering and Leak Detection.** The regional engineering projects that are conducive to the sharing of resources include planning issues, source and transmission issues, and the implementation of those plans. Possible future projects include:

- refinement and expansion of the groundwater model
- regional distribution model that focuses on intermunicipal transfer of water
- development of a joint emergency plan
- detailed financial and legal evaluation of an alternate administrative structure
- leak detection survey

While each of these projects is global in scope, they all have a means of equitably distributing the project costs (i.e., number of customers, length of distribution system, number of sources, etc.). These global planning ventures are suited to joint funding because they benefit all of the participants proportional to the size of the entity.

B. **Insurance.** Each of the water departments maintain property and liability insurance on their individual water systems and Workman's Compensation insurance on their employees. The various municipalities procure insurance for all municipal departments and facilities with the water departments' coverage comprising only a small fraction of the overall municipal premium. Each water department already receives the advantage of economy-of-scale by procuring insurance in conjunction with all of the other municipal departments. Therefore, it is unlikely that a savings would be realized if the various water departments joined together to procure insurance. In addition, the convenience of working with one agency for all of the municipalities' insurance questions and claims is an important consideration. The five participating water departments reportedly spend a total of $54,000 for property/liability and workman's compensation.

C. **Major Capital Projects, Well Redevelopment, and Tank Painting.** Generally, the larger a particular project is, the more economical the unit prices within a bid become. If neighboring communities choose to join forces to bid capital projects, there are pitfalls that make such arrangements dangerous. Those pitfalls include:

1. Who will be the owner of record?

2. How will the responsibility and liability be divided? In the event of a contract dispute, all parties will be involved, even if the disputed work was not being performed within a particular municipality.

3. In the event of a construction accident, all parties will be included in a lawsuit.

4. Will the actions of one municipality towards a contractor (harassment, disputes, and non-prompt payment) affect the contractors' responsiveness to the second party to the agreement?

5. Projects must be on the same schedule (i.e., financing, environmental review, regulatory review, and permits).

In our opinion, it is difficult enough to coordinate and control the administrative, financial, and regulatory issues within a project for a single municipality without having to be concerned about the added legal complexity of including a second municipal entity in the contract.

An alternate arrangement that could be advantageous and manageable would be the bidding of multiple projects of similar type to obtain unit prices based on a larger quantity; then executing individual contracts with the appropriate municipalities. This would work particularly well for projects that can be defined in terms of unit prices. Well redevelopment, and possibly tank painting, are examples of multi-year projects that could lend themselves to joint procurement. Upfront, the bid documents would define the quantity anticipated over a three-year period and establish the anticipated schedule of which wells or tanks would be repaired. After the bids are awarded, individual contracts would be executed with the participating municipalities for the work to be performed in their particular community. Before such joint ventures are developed, each communities' legal counsel must review and approve the concept and the contract details and contract language.

4.5 FUNDING AND FINANCING

One of the categories selected by the Steering Committee for investigation as a potential task for cooperative efforts is grant applications and grant writing. Funding sources for water projects target specific needs. The most widely used funding sources and their particular focus are:

1. Drinking Water State Revolving Fund (DWSRF) targets public health issues. Encourages regionalization, but requires a single political subdivision (municipality, district, or authority) as applicant.

2. USDA's Rural Development - Rural Utility Services targets water infrastructure, but favors grants to lower income communities. Rural Development cannot fund projects for municipal entities with a population of greater than 10,000.

3. Community Development Block Grants focus on grants to low and moderate income areas.

4. Economic Development Administration and Empire State Development target projects that add or retain jobs.

Each of these sources can be used to finance all or part of projects that culminate in capital construction and would be used once a project is identified. The project type and the prime beneficiaries will determine which funding source or sources may be appropriate for capital projects.

Since there is an interest within the water industry to promote regionalization, the joint pursuit of funding for regional planning approaches could be productive. Topics that could attract grants on a multi-community basis include:

- emergency interconnections between communities, including development of a valley-wide distribution model
- development of an emergency plan
- performance of an anti-terrorism vulnerability assessment
- more in-depth investigation of an alternate administrative structure
- expansion of the valley's groundwater model

Once a regional project or projects have been identified, it would be advisable for the Steering Committee to approach a successful grant writer to determine which funding agency or agencies is most appropriate and who the applicant should be. For regional issues, some funding agencies may permit one of the municipal parties to be designated as lead agency; the Appalachian Regional Commission permitted that type of arrangement for the partial funding of this project.

Other funding agencies, such as Empire State Development, may require a regional entity (Southern Tier Central Regional Planning and Development Board) to act as lead agency. There are funding sources available for planning issues and a regional approach will make a lender more interested in a particular project type. The Steering Committee should include funding and grants as a standing item on their agenda.

TABLE 4-1

BUDGET SUMMARY

Category	Expenses					
	Village of Painted Post	Village of Riverside	Town of Erwin	Town of Corning	City of Corning	Total Existing Budgets
Equipment						
Equipment Purchase/Lease		$1,500		$14,600	$84,000	$100,100
Personnel Services						
Wages and Salaries	$48,000	1,000	$88,000	26,400	255,000	418,400
Overtime					10,000	10,000
Temporary Services					5,000	5,000
Fringe Benefits						
FICA/Social Security	3,300	200	4,000	2,000	20,500	30,000
New York State Retirement			4,400		3,000	7,400
Health Insurance	7,200		5,300		57,000	69,500
Workers Compensation	100				20,000	20,100
Unemployment						
Professional Services						
Legal Services						
Engineering Services						
Audit and Accounting Services						
Computer Services						
Human Resources Services						
Insurance			6,700	2,100	25,000	33,800
Other Professional Services					5,000	5,000
Service Contracts						
Contract Services	47,400	7,800	35,600	12,000		102,800
Office Supplies				400	5,400	5,800
Postage and Freight				500		500
Advertising						
Purchased Water		31,500		12,000		43,500
Chemicals	6,000		6,000	2,700	6,300	21,000
Miscellaneous				800		800
O&M Outside Contracts						

TABLE 4-1 (Continued):

Category	Expenses					
	Village of Painted Post	Village of Riverside	Town of Erwin	Town of Corning	City of Corning	Total Existing Budgets
Debt Service			57,000	34,000	415,500	506,500
Miscellaneous Expenses						
Equipment Repairs and Supplies					8,800	8,800
Building/Grounds Repair and Supplies						
Safety Supplies						
Permits						
Easements and Land Taking						
Judgments and Claims						
Laboratory Expenses						
Chemicals and Biological Analysis				2,000	10,200	12,200
Utilities						
Telephone					800	800
Electricity/Power	37,000		60,000	24,500	146,000	267,500
Water and Sewer Charges						
Travel and Training			1,000		2,400	3,400
Vehicle Expenses						
Vehicle Repair					7,500	7,500
Gasoline						
Other						
Contingency		5,000				5,000
Payments to Other Governments					34,600	34,600
Transfer to Capital Projects/Reserve					225,000	225,000
Total Expenses	**$149,000**	**$47,000**	**$268,000**	**$134,000**	**$1,347,000**	**$1,945,000**

TABLE 4-2

CHEMICAL USE AND ANNUAL COST

Gas Chlorine			
Water System	**Quantity (lbs/year)**	**Cost/Unit ($/lb)**	**Annual Cost**
Town of Erwin	2,250	$0.58	$1,300
Town of Corning			
Village of Painted Post	1,800	$0.48	860
Village of Riverside			
City of Corning	5,700	$0.45	2,560
Total	**9,750**		**$4,720**
Liquid Chlorine (Sodium Hypochlorite)			
Water System	**Quantity (gal/year)**	**Cost/Unit ($/lb)**	**Annual Cost**
Town of Erwin			
Town of Corning			
Village of Painted Post	20	$1.30	$30
Village of Riverside			
City of Corning	1,900	$0.69	1,310
Total	**1,920**		**$1,340**
Other Chemicals			
Chemical	**Location**	**Quantity Used**	**Annual Cost**
Sodium Fluoride	Village of Painted Post	2,000 lbs	$1,940
	Town of Erwin	2,000 lbs	$1,960
Corrosion Inhibitor	Village of Painted Post	385 gallons	$2,440
	Town of Erwin	300 gallons	$2,250

TABLE 4-3

ELECTRICAL USAGE AND COST

Location	Annual Cost	Annual Usage (KW/Hour)	Total Annual Cost (%)
Town of Erwin	$54,000	330,000	24
Town of Corning	17,000	N/A	7
Village of Painted Post	36,000	300,000	16
Village of Riverside			
City of Corning	121,000	1,230,000	53
Total	**$228,000**		**100**

N/A - Not Available

TABLE 4-4

MUNICIPALLY-OWNED VEHICLES AND EQUIPMENT

	Town of Erwin			Town of Corning [1]			Village of Painted Post			Village of Riverside			City of Corning		
	No.	Shared [2]	Time Used	No.	Shared [2]	Time Used	No.	Shared [2]	Time Used	No.	Shared [2]	Time Used	No.	Shared [2]	Time Used
Automobiles							1	No		1	No				
Trucks	2	No		1	No					3	Yes		5	No	
Confined Space Blower										1	Yes		1	No	
Confined Space Air Quality Monitor	1	Yes								1	Yes		1	No	
Air Compressor							1	Yes	0-16 hr/wk				1	No	
4-Inch Missile													1	No	
1¾-Inch Missile													1	No	
2-Inch Trash Pumps	1	Yes											2	No	
3-Inch Diaphragm Pump													1	No	
Hydraulic Pipe Cutter													1	No	
Hoe Mounted Jackhammer													1	No	
Jumping Jack Tamps													2	No	
Electric Chipping Hammer													1	No	
Large Meter Tester													1	No	
Hydraulic Shoring System													1	No	
Box Type Shoring System													2	No	
Cut-Off Saws															
Backhoe	1	Yes	10 days/yr			[2]	1	Yes	0-16 hr/wk				1	No	
Dump Trucks						[2]	1	Yes	0-16 hr/wk				2	No	

[1] *Town of Corning utilizes Highway Department equipment, average two hours per week.*
[2] *Shared with other intermunicipal departments.*

TABLE 4-5

SUMMARY OF STAFFING

Position	Town of Erwin	Town of Corning	Village of Painted Post	Village of Riverside	City of Corning
Water Distribution System Supervisor	1				1
Water Maintenance Supervisor				.5	1
Water Treatment Plant Operator	1	1	1		2
Maintenance				1	1
Heavy Equipment Operator					1
Motor Equipment Operator					1
Water Maintenance					1
Meter Reader		1	1		1
Account Clerk/Typist				1	1
Summer Laborer					1
Total	**2**	**2**	**2**	**2.5**	**11**

CHAPTER 5

ADMINISTRATIVE STRUCTURES

5.1 INTRODUCTION

As public concerns about the quality of our water supplies and distribution networks come under ever increasing scrutiny (Lavelle and Kurlantzick, 2002; Montaigne, 2002), the management and operation of those systems will require greater understanding of how those systems operate and how they can be kept at peak performance. In the water-rich northeastern states, a plentiful supply of high quality drinking water has historically been taken for granted. However, in an era of dramatically increased federal regulations and aging water systems, it becomes more and more difficult for the smaller municipal systems to continue to provide the level of service expected by the public and the regulators.

The purveyors of potable water in the Chemung River Valley face the same challenges that face the purveyors in the remainder of the northeastern states. Aging infrastructure and newly enacted drinking water regulations which target groundwater sources will affect the communities within the study area. Since the Northeast was settled earlier than the other portions of the nation, centralized water systems were developed at an early time. Water systems developed in the early 1900s still rely on piping networks that were constructed at that time; those facilities are approaching their effective life. Over the next two decades, several systems in the Corning area face costly distribution replacement or rehabilitation programs. As unlined cast iron pipes age, their carrying capacity decreases and leakage increase as a result of tuberculation caused by both internal and external corrosion. Therefore, a systematic program to replace the older pipes must be developed and implemented. Since the older pipe in any system is typically located in the most congested portions of the municipality, the cost of replacement is high due to the conflicts with other utilities, the large number of service connections, and the significant replacement costs. In the Northeast, the water main replacement cost is the most significant expense facing the water industry in the 21st Century.

In addition to the aging infrastructure, "the next five years will see more new rules than have been adopted in all the years since the enactment of the Safe Drinking Water Act in 1974" (Lavelle and Kurlantzick, 2002). These new rules affect groundwater sources through both

stricter water quality standards and through the treatment rules, such as the Groundwater Rule and the Surface Water Treatment Rule. The Groundwater Rule requires that wells drawing from an aquifer susceptible to fecal contamination must provide disinfection that achieves 99.99 percent inactivation of viruses. This is relatively easy to achieve using chlorination, provided there is sufficient contact time to permit the required kill of microorganisms; wells located in the center of a distribution system may be required to provide storage to obtain the required chlorine contact time.

The Surface Water Treatment Rule (SWTR) has a provision that requires filtration for wells that are directly under the influence of surface water. The New York State Department of Health has recently prepared a flow chart to identify whether a supply is groundwater under the influence of surface water (GWUI); a copy of that procedure is included in Appendix B. In the Corning area, this could require treatment, but more likely would require the siting and use of potable water wells that are not GWUI. Even so, this could result in a significant cost to the purveyor.

The higher expectations of the public, the ever-increasing regulations, and the need to address security concerns in light of terrorist threats all point to the need for regional water supply systems or at least individual systems that work closely together and proactively seek to safeguard the public. One of the charges from the Chemung River Valley Steering Committee was to identify the administrative structure that provides the water system management that most "effectively and efficiently" serves the water customers of the valley. While this involves meeting the ever more complex water quality regulations previously discussed in this section, it also involves regulation on other fronts. The water purveyor must also comply with workplace training requirements (sexual harassment and EEO issues); safety issues (confined space, trench safety, etc.); employee satisfaction and organized labor issues; backflow prevention programs; equitable and competitive water rates and the development of and preparedness for implementing a valley-wide emergency plan, aquifer protection plan, and drought management plan. This increasing complexity of the water industry points to the need for a regional approach to water supply, treatment, and service. New York State has long recognized the desirability of regionalization and currently provides additional emphasis on regionalization when scoring projects for funding under the state's Drinking Water State Revolving Fund.

Six different administrative structures were investigated for use in the study: status quo, intermunicipal agreements, county water district, regional water authority, county water agency, and a public/private water commission. The main reasons that the Steering Committee pursued

alternative administrative structures was the potential for cost savings resulting from "economy of scale" purchases, the ability to improve water service to the valley, and for improved cooperative efforts relative to long-range planning activities. Currently, there is limited sharing of resources among the communities and no area-wide emergency plan or drought management plan in place. Advantages and disadvantages of each type structure were examined, compared, and discussed with the Steering Committee members to determine the best way(s) for the five municipalities to cooperate and manage their collective water systems.

5.2 DESCRIPTIONS

A. **Status Quo.** The status quo administrative structure is the system currently utilized by the communities in which each political subdivision operates a water system independent of their neighbors. Politically, this structure is the easiest to maintain. Each individual governing board controls expenditures and the direction of their programs and each community retains autonomy and control of their water system. The internal economic efficiency of the villages' and towns' resources is maximized since many communities share personnel and equipment among departments, such as the Public Works, Water, and Sewer Departments (i.e., Water/Sewer Superintendent, operators licensed in water/sewer, single backhoe/operator used by Water, Sewer and/or Public Works).

The Towns of Erwin and Corning and the Villages of Painted Post and Riverside currently share both personnel and equipment among their various departments. The initial capital cost of major construction equipment (i.e., backhoe, dump trucks, and loaders) may be too great a burden for one department to justify without inter-departmental sharing. Likewise for personnel, employees hired jointly by two departments may find that they are more efficiently used than if they worked for only one department. However, under the current system, the smaller communities have fewer economic resources to have specialists on staff, i.e., electricians, mechanics, equipment operators, and water quality experts. For the smaller communities, there is no budget available to hire specialized staff employees, since they would be needed only on a part-time basis.

By retaining the status quo, there is a duplication of efforts among the various communities on a number of categories. Specifically, these areas are the overall staff size, regulatory reporting, billing systems, and equipment and materials inventory. With the existing administrative structure, there is limited opportunity to share resources between communities. One of the largest disadvantages of the status quo structure is that there is no mechanism for centralized protection

of the water source. Neighboring communities in the Chemung Valley all draw on the same aquifer for their own consumptive needs and there is no assurance that individual purveyors of water will not place these individual needs above the needs of the valley as a whole. These disadvantages of the current system prompted the consideration of alternative administrative structures. Because status quo is the system currently utilized by the communities, it was used as a baseline for comparison of all other administrative structures examined.

Table 5-1 summarizes the advantages and disadvantages of the existing structure (status quo).

B. **Intermunicipal Agreements.** Intermunicipal agreements are contracts written to permit a variety of cooperative endeavors between or among neighboring communities. These agreements work best if they are specific and define every aspect of the cooperative effort. That is, the agreement should define the task, compensation, availability for cooperative effort, what sets priority, who is in charge, and the ramifications if a party fails to perform. Examples of tasks that could be shared among water departments are supplementing sources of supply (intermunicipal sale of water), material/equipment purchasing, resources (labor and/or equipment), maintaining a joint inventory, drought management, water conservation, and staff training. As with the status quo, intermunicipal agreements between communities would be easy to implement from a political perspective. Intermunicipal agreements allow for the sharing of resources, yet each entity would generally remain in control and have autonomy over its water system and staff. However, intermunicpal agreements require unselfish cooperation and a desire by all parties to make the arrangement work. Local disputes and political differences could compromise or interfere with the performance of the agreement. Also, communities that lack significant resources could find themselves very dependent on the availability of shared resources from other communities. In addition to having an honest willingness to make cooperation work, each community must budget for the development, coordination, and overall administration of these agreements. These efforts will require significant managerial efforts on the part of each participant. Table 5-1 summarizes the advantages/disadvantages of intermunicipal agreements to facilitate municipal cooperation.

C. **County or Part-County Water Districts.** County-wide and Part-County water districts can be established in accordance with County Law Article 5A. These water districts provide the legal mechanism to serve multiple towns, villages, and cities under a centralized administrative structure. County and Part-County districts are created by the County legislature. The

legislature becomes the governing body for the district and must approve the annual budget for a county water district.

County districts have flexibility in their method of revenue generation (see Table 5-1). Similar to town districts, county districts must generate all of these revenue from within the district boundaries. However, the flexibility exists in that revenue can be generated both from property taxes and/or from the sale of water. Ancillary benefits, such as fire protection and improved development potential, can be worked into a rate schedule so that all entities benefiting from the water system pay their fair share.

The creation of an entity that encompasses the entire study area and is administered at the County level offers the potential for more efficient use of resources. A centralized staff serving the five production/distribution systems could eliminate the redundancy of each political entity (city, village, town) having similar classifications of employees performing the same tasks (i.e., multiple superintendents, treatment plant operators, equipment operators, and mechanics). More efficient use of staff for existing functions could free up funds for savings or to hire specialized personnel to better serve the larger customer base. Examples of specialized personnel could include a manager, construction specialist, water quality expert, electrician/instrumentation specialist, or water engineer). Not only does the larger customer base make additional funds available, but the larger system size creates an increased need for specialized services, which can justify the additional staff classifications.

Also, because there would be one controlling body of the unified water department, there would be no disputes concerning sharing of resources or the availability of resources. However, each community would lose local control of their distribution systems, including all maintenance, staffing, and improvements associated with it.

As previously mentioned, the budgets to carry out maintenance and improvements would no longer be a part of the local budgets and would be removed from local decision making. The budgets would now be part of the county budget, voted on by the county legislature. County water districts would have the ease of capital financing made possible by having the financial backing of the County. Taxing is permissible for county water districts, and as the revenues of the county district increased, they would be able to expand their service area beyond the area of initial implementation. However, the service area would be limited by the boundaries of the county. Although the county water district allows the centralizing of staff and resources that

intermunicpal agreements and status quo do not, the disadvantage of adding another layer of governmental control and the requirement of county legislature-approved budgets caused the Steering Committee to eliminate this option from further consideration. Refer to Table 5-1 for a summary of the advantages and disadvantages of County Water Districts.

D. **County Water Agency.** A county water agency is typically the first step towards formation of a water authority. It is an advisory and planning organization formed under County Law Article 5A (Stearns & Wheler, 1989) and has advantages similar to that of a county water district. Agencies can provide for centralized planning, such as aquifer protection and drought management. Where a county water district has the ability to enforce policies, the county water agency has no implementation power. It is merely able to assist local entities with planning from a regional perspective. Also, the same budget problems exist as with a county water district. The county water agency's budget would be a part of the county budget. However, since an agency has no means of generating revenue, it is reliant on the County for an appropriation to continue functioning from year to year. Appropriations can hinge on the popularity of current programs and can lead to abuses. There is no assurance that the finances would be available from year to year. Because of these reasons, the county water agency was not investigated further.

E. **Water Commission.** A water commission is a specialized and infrequently used method of joining water purveyors from multiple political subdivisions (i.e., towns, cities, villages) and can include both municipalities and private water systems. The closest area to Steuben County served by a water commission is the area at the south end of Cayuga Lake; the Southern Cayuga Lake Intermunicipal Water Commission was established in 1974 "under an Agreement of Municipal Cooperation (AMC) in accordance with New York State General Municipal Law Article 5-G" (Gell etal, 2001). In the Corning area, a commission could include the municipal entities participating in this study, plus one or more of the larger industrial systems (i.e., Corning, Inc.). None of the other administrative mechanisms evaluated have the legal authority to include private enterprise in the public sector management and decision making process. On the other hand, all municipal structures are sensitive to the needs of their industrial constituents and strive to maintain an atmosphere that permits industry to flourish. Typically, a water commission would own the sources of supply and treatment; but in contrast to a county water agency or county water district, the entities would have the option of retaining ownership and control of distribution. The various entities could retain some autonomy and control of their systems (similar to the status quo and intermunicpal agreement options), but the commission would make decisions for the system as a whole. Commissions are governed by an independent Board and

operate without the interference of local politics. Each entity would have designated representatives with equally weighted votes for each community. The commission decides on budgets, staffing, and capital improvements. This could be a disadvantage to older systems in need of large improvements and a benefit to newer systems with no capital improvement needs. Not only will each entity be required to financially support the commission, but also could be responsible for their own capital improvements; this could result in lopsided (though equitable) water rates among the participating entities.

Because the development of a centralized source and treatment facility is not under consideration, the commission does not offer any advantages that more traditional options offer (i.e., intermunicipal agreements and water authorities). Since there is little incentive for an industrial entity to participate in the commission, this structure was not examined further.

F. **Regional Water Authority.** The preferred administrative structure for the larger metropolitan water systems throughout the state (Erie County, Monroe County, Suffolk County, and Onondaga County) is an authority. Authorities have the flexibility of being either a retailer or wholesaler of water. Therefore, member communities can either rely on the authority for all water system needs (from source water/treatment to distribution/billing), or the community can retain control of their own distribution systems and look to the authority for the purchase of treated potable water that the community then dispenses. Individual water authorities are permitted both retail and wholesale customers; however, if a significant number of municipalities forming the authority choose to be wholesale customers and retain the operation of their distribution system, the authority structure would lose its economy-of-scale and become uneconomical. An equitable alternative would be for the municipality or municipalities to retain ownership of the distribution system, but have the authority to operate and maintain those facilities.

Water authorities are chartered under the New York State Public Authorities Law. Each individual authority must be specifically formed by an act of the New York State Legislature. Consequently, the length of time required for approval is in the hands of the legislature and the formation, once it is in the legislative process, can take two to three years. This timeframe follows the anticipated two to three-year interval required to educate and obtain the endorsement of the various political entities participating in the authority. Therefore, the overall process to form an authority can take four to five years.

Table 5-1 identifies the advantages and disadvantages of an authority structure for managing a water system. The primary advantages of an authority are:

1. Ability to regionally manage the valley's water resources.

2. Economy-of-scale without the political pressures to favor one participant over another.

3. Flexibility in: (a) establishing service area boundaries; and (b) type of customer served (wholesale and retail).

Additionally, since an authority is not financially reliant on the local communities or county, it must generate revenues in order to remain self-sufficient. The annual budget must be offset by revenues derived from the sale of water; Authorities have no ability to tax. Therefore, Authorities are driven by sales to produce growth. Since an authority's service area is relatively easily expanded, there is incentive for an authority to expand to increase sales. This incentive for expansion forces an authority to become aware of the current water supply trends so that the questions of potential customers can be answered.

The principal disadvantage of a water authority, from some people's perspective, is the elimination of the local control that communities currently have over their systems. However, the Steering Committee believed the advantages outweighed the disadvantages for this structure. A water authority was the option that the Steering Committee was most interested in further investigating and comparing to status quo with intermunicipal agreements. A cost-effective analysis of an authority versus the communities' status quo is examined in the next section.

5.3 BUDGET COST ANALYSIS

Table 5-2 summarizes the existing water budgets for the five municipalities participating in this project. The budget format utilized for Table 5-2 is the budget form adopted by the Livingston County Water and Sewer Authority (LCWA) for their accounting purposes. This format is similar to the breakdown used by the City of Corning, but is much more detailed than the budget format used by the towns (Erwin and Corning) and villages (Painted Post and Riverside). These entities generally divide the budget expenditures into four sectors of water production: Administration; Source of Supply; Power and Pumping; Purification; and Transmission and

Distribution. Within each of the above-listed sectors, the budget is apportioned according to personal services (labor), equipment, and contractual services. Based on the individual community's responses to the three questionnaires distributed during this investigation and the budgets submitted by the municipalities, Stearns & Wheler applied the budgets to the accounting format of the LCWA. Where Stearns & Wheler was unable to break down the existing budgets into this format, two line items were used to carry budget items that could not be otherwise accounted for. Those line items are "Equipment Purchase/Lease" and "Contract Services."

In addition to summarizing the existing water budgets of the project participants, Table 5-2 also presents an estimated budget if an authority were created to serve the same area. While it is tempting to directly compare the sum total of the existing budgets with the estimated water authority budget, this comparison of total expenses does not accurately represent the true cost of production. The following discrepancies prevent a true comparison:

1. Some services in the existing budget are financed through the General Fund for some of the municipalities, and the cost of these services is not reflected in the individual water budgets. Examples of these expenses are legal fees, auditing services, human resources, computer services, and some clerical staffing.

2. The authority budget includes the cost of repayment of existing serial bonds. Those bonds are associated with the cost of recent construction projects as reflected in the budget for the individual communities. What is not included in the authority budget is the cost of purchasing or leasing the existing infrastructure (wells, distribution systems, and storage tanks) from the city, towns, and villages. To determine these expenses would require a valuation of the existing facilities. Such a valuation would consider the facilities to be used, the age of those facilities, their effective life, and their depreciation. This valuation assessment is beyond the scope of this study an would be included in a detailed financial assessment if an authority that owned all infrastructure appeared to be the desired administrative structure.

3. Upfront costs of establishing an authority are not reflect in the budget. Upfront costs include:

    a. Establishment of the details of the authority structure.

b. Education of communities; obtain agreement from participating entities.

c. Develop staffing plan (including union negotiations, if appropriate).

d. Evaluate the infrastructure to determine its viability; identify short-term improvements.

e. Cost valuation of each system or portion of system to be acquired.

f. Transfer or lease of infrastructure from various participants.

g. Write and obtain passage of state legislation establishing an authority.

h. Legal costs associated with establishment of an authority.

The one-time upfront costs could be significant (estimated range of $200,000 to $300,000), depending on the complexity of system arrangement.

One of the major advantages of an authority is its flexibility. While authorities can be structured to purchase and own infrastructure, they can also be structured to only operate systems owned by others. As an example, each municipality could retain ownership of their water system infrastructure and the authority could provide all management, operations, and billing functions for the individual municipalities. This type of structure would minimize the upfront costs and eliminate the disagreements over the value of individual systems.

The purchase or lease of the existing infrastructure by an authority would represent a significant investment that would need to be recouped through water rates. If the systems were purchased or leased by the Authority, the city, villages, and towns would receive payments for the purchase. These revenues could be redistributed to the taxpayers. These payments would increase the individual General Fund revenues and reduce their required taxes. However, the authority's water rates must be increased proportionally to meet these payments. The difficulty in determining fair compensation for the purchase of the water infrastructure is compounded when the age of that infrastructure varies dramatically from community to community. This is true across the Chemung River Valley study area; Erwin has a relatively new distribution system, whereas Painted Post and Corning have significantly older facilities. This type of discrepancy

reinforces the importance of accurately documenting the value of the individual systems and establishing the method of compensation for their use. An equitable means of solving this discrepancy is to have the individual communities retain ownership of their distribution system and be responsible for the cost of future rehabilitation of that system. Future expansion, however, would typically be funded by the authority and not by the individual municipality. With this scenario, each community would have a different rate structure under the authority's billing system; rates would vary depending on the debt incurred for capital improvements.

In Table 5-2, the following general components can be compared between the existing structure and that of a water authority: staff size, personal services (wages and benefits), professional services, utilities, and contribution to Capital Reserve Fund.

A. **Staffing and Compensation.** With the existing independent operation of the 5 water systems, 13 full-time and 7 part-time personnel are used for the management, operation, maintenance, meter reading/billing, and accounting. A number of these part-time personnel have very limited responsibility towards the water system (i.e., Village of Riverside). If the 5 systems were to be operated as a water authority, it is estimated that the overall system could be managed and operated with a 13-person full-time staff with 1 summer intern. These labor estimates were used in the financial analysis presented in Table 5-2. One possible staffing plan is envisioned as follows:

- Executive Director (1)
- supervisors, operators, and maintenance personnel (8)
- equipment operators (2)
- bookkeeper/clerk (1)
- clerk (1)

Under this staffing scenario, the number of supervisors, operators, and maintenance personnel is reduced. However, the number of administrative personnel (director and clerks) is increased. Since the creation of an authority establishes an independent structure that must be managed and remain accountable to its Board of Directors, administrative responsibilities will be more prominent than they are in the current municipal structure. Administrative management responsibilities will be borne by the Executive Director with support of supervisory staff and outside consultants. Administrative duties will include managing operations personnel (hire/fire, payroll, benefits, retirement, human resources); accounting (accounts payable and receivable,

annual financial statement); inventory; and customer relations. Many of these tasks are currently performed by the municipal administration (i.e., town/city manager, mayor/supervisor) and not by the individual water departments. Frequently, water departments deal only with the technical and operations and maintenance issues.

Even through an authority would add a full-time administrative level that does not currently exist in the water department structure, it is likely that the overall cost of labor (wages and benefits) can be reduced by approximately 10 percent if an authority is created.

B. **Professional Services.** One area where an authority is likely to have noticeably greater costs than the water department structure is in professional services. An authority will have monthly board meetings that are open to the public, as well as the participating municipalities. Since the authority will interact with this diverse mix of municipalities as an autonomous entity, an increase level of legal and enginecring assistance is envisioned.

Rather than employ a staff member that specializes in human resources, this expertise can most economically be provided by an outside source. This outside source can be a consultant, or an arrangement could be made with the county to provide this expertise on a fee-for-service basis.

As an independent entity, the water authority must be audited on an annual basis. This audit would be performed by an independent auditing firm. While municipalities are also audited, the cost of that review is frequently not passed on to the individual water departments.

The water authority will be a technical organization that is heavily reliant on computer systems for recordkeeping, accounting, billing, and word processing. Additional computer capabilities could be developed for inventory control, mapping, and scheduling. The development and implementation of a computer network will have an intensive upfront component as well as an ongoing annual cost for maintenance, expansion, and technical support.

Table 5-2 estimates the routine cost to an authority for professional services. These costs are estimated to be $100,000 per year. Similar costs were not identifiable in the municipal budgets.

C. **Utilities.** Utility costs include telephone, electrical power, natural gas, and sewer service. Since all of the sources of supply within the service area are groundwater, the utility costs are

dominated by the pumping costs. No significant change in utility cost is foreseen as a result of the change in administrative structure to a water authority.

5.4 RECOMMENDED ALTERNATIVES

As previously discussed, six administrative structures were evaluated for this study. Based on the advantages and disadvantages developed for those six structures, the Steering Committee expressed an interest in further considering the intermunicipal agreements and water authority as a means of administering the water systems within the study area. The two organizational structures are diverse in that one alternative (water authority) unites the five water systems under a single administrative umbrella, whereas the other structure (intermunicipal agreements) retains the independent administration of each of the five municipal water systems.

The water authority is particularly attractive as an administrative framework because it creates an independent organization with a central mission of meeting the water supply, treatment, and distribution requirements of its constituency. While individual water departments have a similar mission, typically, smaller communities do not have the resources available to perform to the same standards as a water authority. By uniting multiple water systems under a central structure, a water authority is able to do more with fewer people, thereby enabling a higher level of service to be provided for the same cost. Therefore, the first area in which a water authority shines is customer service.

The second area in which a water authority excels is in offering flexibility to its customers. The authority can be structured to sell water on either a wholesale or retail basis. In addition, the authority can own, lease, or have the municipal entity own the infrastructure within their corporate boundaries. The cost of water is directly related to the type of infrastructure ownership selected.

The administrative structure of a water authority that includes an executive director and an outside board of directors involves personnel in the process that have the charge of looking at the overall business of production and sale of water. Too frequently, the operations staff of smaller water systems is focused on the minute details of operation and maintenance and does not have the time or training to look at the big picture. A major advantage of a water authority is that the structure permits the system to be operated as a business. As such, excess revenues are retained to finance water needs, such as capital improvements, staffing, training, or public education. The

executive director will be the spokesperson for the water infrastructure, and as a seasoned water professional, will be better able to establish priorities for implementing capital improvements.

All too frequently, individual systems that are not shielded from political pressure utilize excess revenues to artificially maintain lower water rates. When revenues earmarked for maintenance or future capital expenditures are used to defray operating expenses, the overall health of the water system suffers. This is a major reason that the infrastructure in the Northeast is sorely in need of renovation. Municipalities have allowed the aging infrastructure to deteriorate rather than raise water rates or taxes sufficiently to systematically upgrade this infrastructure.

An authority is guided by a board of directors and an executive director that can focus on water issues and provide a level of sophistication that is not typically available in the management of smaller systems. Since the authority has a single focus, it is better able to operate and maintain a sound water system and to educate their customers on water issues. A better informed public guided by a group of seasoned water professionals will more readily support the making of improvements to public water supplies. In New York State, the authority structure has served the water industry well for almost 50 years. Some of the best run water systems in the state are regional systems utilizing the state's authority structure. These authorities have a working group that meets regularly to discuss water issues and to share ideas. Through this interaction and the implementation of these shared ideas, these purveyors improve the overall efficiency of their systems.

Because of the wide discrepancy in age of infrastructure between the older communities (i.e., Corning and Painted Post) and the newly developed communities (Town of Erwin), one attractive option would be to have the communities continue to retain ownership of their individual distribution systems. A water authority could be established to either own or lease the sources of supply. Under this scenario, the authority staff would:

1. Manage the water systems collectively.
2. Operate the water system as one entity.
3. Provide routine maintenance.
4. Provide meter reading and billing services.

Major repairs or expansions would be provided by the authority; however, the cost of major renovations would be borne by the individual communities. If the need for purchasing

infrastructure and for accounting for short-term renovations is eliminated, the initial costs of establishing a water authority can be dramatically reduced.

The major advantage to retaining individual municipal systems that cooperate based on intermunicipal agreements is that the individual communities retain control over their existing systems. In addition, the water department staff is made up of employees of the municipality, and as such, can be utilized to assist other departments. The Town of Erwin, Town of Corning, and Villages of Riverside and Painted Post rely on these interdepartmental sharing opportunities to help minimize the size of the staff required in those other departments. If an authority is formed, the individual communities will lose the ability to share people from the Water Department with other departments; therefore, this may result in slightly higher sewer or public works department staffing requirements. The economy of scale that an authority realizes by centralizing staff to serve multiple communities is similar to the economy of scale that municipalities realize when they utilize interdepartmental sharing of personnel. While smaller communities typically do not provide the same level of service that is realized through a centralized management structure, this level of service can be improved by developing intermunicipal agreements that share personnel between communities.

Examples of intermunicipal agreements that can assist communities in improving service are:

1. Licensed system operation.
2. Cooperative efforts in providing emergency water supplies.
3. Cooperation in drought management situations.
4. Centralized inventory.
5. Assistance in major maintenance items.
6. Cooperative training efforts.
7. Establishing a forum for sharing of knowledge of regulations, safety, and funding sources.

While the individual water systems have adequately served the valley over the last 100 years, the water departments are subjected to political pressure that can compromise their effectiveness. A major advantage of a water authority is that political pressure is minimized, since the authority is its own political entity. Without political pressure, the priorities can be established based on true need rather than political clout.

In summary, a water authority will provide a greater level of service to the water customers within the valley. Operational efficiency and effectiveness are best served by the regional approach where the larger economic base will permit a more proactive management of the system to minimize negative water issues.

The evaluation as to whether or not a water authority is appropriate must be made by each of the participating communities. In evaluating the appropriateness of establishing a water authority, each community must answer the following questions:

1. What will be the cost of establishing an authority in my community?

2. How much control over our water supply system are we willing to relinquish?

3. Are we willing to create a new legal entity? Are we willing to pay the initial and ongoing costs of supporting this entity?

If the answers to these questions are favorable for all communities, then each municipality must determine their desires relative to continued ownership of the infrastructure, keeping in mind that continued ownership of infrastructure will lessen the initial costs associated with the establishment of a water authority. In our opinion, the financial impact and controversy of establishing a water authority will be greatly reduced by having each municipality continue its ownership of at least the distribution system and possibly the water storage facilities that they currently own. While the level of service provided by a water authority is typically higher than that provided by individual municipalities, the cost of that increased service is also evident. We would anticipate the cost of water with an authority type of administrative structure to be equal to or greater than the cost of water under the existing management structure. The primary reasons for cost increases is the costs associated with establishing a new legal entity and the costs associated with improved reliability and a proactive rehabilitation program for aging infrastructure.

We recommend the participants in the Steering Committee continue to meet on a regular basis to discuss water issues and, in particular, to discuss the concept of regionalization. As the public and the press increasingly question the safety and condition of our product and our infrastructure, there will be increased pressure to regionalize. The proximity of the six water purveyors in the

Chemung River Valley to each other makes regionalization an obvious and convenient choice for consideration.

TABLE 5-1

COMPARISON OF ADMINISTRATIVE STRUCTURES

Administrative Structure	Advantages	Disadvantages
Status Quo	• Each community retains autonomy and control of their system. • Sharing of personnel and equipment maximizes internal efficiency for towns and villages (towns/villages share DPW resources). • Politically the cleanest – voters feel that they have control of expenditures, direction of programs.	• No economy of scale. • Fewer resources to have specialists on staff (i.e., electrician, instrumentation, water quality experts, mechanics, equipment operators, administrators). • Redundancy in reporting, training, billing systems, equipment/inventory, administration). Each community does their own. • Local (not regional) resource protection. Concerned with local zone of influence (contamination) and yield.
Intermunicipal Agreements	• Each entity retains autonomy and control. • Flexible. Can be structured for: - Purchasing - Sharing of resources (labor, equipment) or management of resources - Facilitating sale of water (supply augmentation/ emergency supply) - Drought management/water conservation - Aquifer protection • Ease of implementation – administered locally. • Can result in economy-of-scale. Agreement to share and co-finance specialists.	• Dependence on other communities (may stress availability of resources). • Requires cooperation; administrative differences can interfere with performance; local political disputes can compromise performance. • Fewer resources to have specialists on staff (i.e., electrician, instrumentation, water quality experts, mechanics, equipment operators, administrators). • Redundancy in reporting, training, billing systems, equipment/inventory, administration may exist. • Local (not regional) resource protection - zone of influence (contamination) and quantity/yield; however, can agree on cooperative effort.

TABLE 5-1 (Continued):

Administrative Structure	Advantages	Disadvantages
County Water Districts	• Ease of capital financing (taxing, water sales, and benefit charges are permissible). • Economies of scale. • More centralized resources available (specialists, etc.). • Potentially higher bond rating than for individual municipalities. • Regional aquifer protection/drought management. • Ability to expand service area due to larger user base.	• Legal fees (associated with establishment). • Lack of local control. • Political agreement required (potential referendum). • Limited to boundaries of the County. • Adds another layer of government to water system.
Regional Water Authority	• Flexibility for expanding service areas due to larger user base. • Economies of scale. • More centralized resources available (specialists, etc.). • Potentially higher bond rating than for individual municipalities. • Capital projects exempt from Wicke's Law. • Administration not driven by local political interests. • Stronger aquifer protection; more regional enforcement. • Regional perspective. • Revenue must come from water sales. • Flexibility in ownership and/or operations; can have wholesale and/or retail customers.	• Administration not driven by local interests. • Lack of completely local control. • State legislature approval required; time and cost required to form an Authority. • No taxing capabilities. • Fees associated with formation (engineering, legal, and financial)
County Water Agency	• First step to County Water Authority. • Advisory/planning organization. • Aquifer/drought advisory/conservation. • Regional perspective. • Assist local entities with planning.	• Funded by County appropriation; finances not assured from year to year. • No enforcement/no power to implement solutions.

TABLE 5-2

BUDGET SUMMARY

Category	Expenses						
	Village of Painted Post	Village of Riverside	Town of Erwin	Town of Corning	City of Corning	Total Existing Budgets	Estimated Water Authority Budget
Equipment							
Equipment Purchase/Lease		$1,500		$14,600	$84,000	$100,100	$110,000
Personnel Services							
Wages and Salaries	$48,000	1,000	$88,000	26,400	255,000	418,400	350,000
Overtime					10,000	10,000	10,000
Temporary Services					5,000	5,000	5,000
Fringe Benefits							
FICA/Social Security	3,300	200	4,000	2,000	20,500	30,000	28,000
New York State Retirement			4,400		3,000	7,400	11,000
Health Insurance	7,200		5,300		57,000	69,500	78,000
Workers Compensation	100				20,000	20,100	26,000
Unemployment							
Professional Services							
Legal Services							20,000
Engineering Services							30,000
Audit and Accounting Services							10,000
Computer Services							10,000
Human Resources Services							30,000
Insurance			6,700	2,100	25,000	33,800	40,000
Other Professional Services					5,000	5,000	
Service Contracts							
Contract Services	47,400	7,800	35,600	12,000		102,800	20,000
Office Supplies				400	5,400	5,800	5,000
Postage and Freight				500		500	10,000
Advertising							1,000
Purchased Water		31,500		12,000		43,500	12,000
Chemicals	6,000		6,000	2,700	6,300	21,000	20,000
Miscellaneous				800		800	
O&M Outside Contracts							

TABLE 5-2 (Continued):

Category	Expenses						
	Village of Painted Post	Village of Riverside	Town of Erwin	Town of Corning	City of Corning	Total Existing Budgets	Estimated Water Authority Budget
Debt Service			57,000	34,000	415,500	506,500	506,000
Miscellaneous Expenses							
Equipment Repairs and Supplies					8,800	8,800	10,000
Building/Grounds Repair and Supplies							30,000
Safety Supplies							2,000
Permits							
Easements and Land Taking							
Judgments and Claims							
Laboratory Expenses							
Chemicals and Biological Analysis				2,000	10,200	12,200	20,000
Utilities							
Telephone					800	800	3,000
Electricity/Power	37,000		60,000	24,500	146,000	267,500	267,000
Water and Sewer Charges							1,000
Travel and Training			1,000		2,400	3,400	3,000
Vehicle Expenses							
Vehicle Repair					7,500	7,500	2,000
Gasoline							10,000
Other							
Contingency		5,000				5,000	85,000
Payments to Other Governments					34,600	34,600	
Transfer to Capital Projects/Reserve					225,000	225,000	225,000 (1)
Total Expenses	**$149,000**	**$47,000**	**$268,000**	**$134,000**	**$1,347,000**	**$1,945,000**	**$1,995,000**

(1) Each entity should have a Capital Reserve Fund. For an authority, the amount of that Fund would be determined based on an assessment of each system.

CHAPTER 6

GROUNDWATER MODELING

6.1 INTRODUCTION

The Corning Area Aquifer Groundwater Flow Model (CAAM) was originally developed by the Susquehanna River Basin Commission (SRBC) to investigate the impact of industrial and municipal groundwater withdrawals on the aquifer during an extreme drought. The CAAM was developed using the Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW), by McDonald and Harbaugh (1984). MODFLOW was utilized for the analysis at the time because it was (and still is) the most widely utilized and accepted groundwater flow model available. In addition, MODFLOW allows the user to incorporate impacts due to aquifer boundaries, leakage to and from surface water bodies, as well as variations in aquifer thickness. The model development, calibration, and simulated results are documented in "Groundwater Flow Model of the Corning Area, New York" (Ballaron, 1988).

As part of the Chemung River Valley Water Study, Leggette, Brashears & Graham (LBG) was tasked with using the CAAM developed in 1988 to estimate the long-term yield of the aquifer and to aid in the development of triggers for the implementation of a drought management plan. This was to be done by obtaining the original data input files needed to run the CAAM from the SRBC. With the model files in hand, LBG was to have reviewed the model structure and determined what upgrades and/or additional data would be required to allow the model to be used as a more effective groundwater management tool in the future. When the model review was completed, some of the more easily implemented changes, such as updating the pumping data, was to have been incorporated into the CAAM. The updated CAAM would then be run to evaluate groundwater levels and potential induced infiltration under drought conditions - data needed to estimate the long-term yield of the aquifer.

LBG was unable to obtain the data input files needed to run the CAAM because the files were lost when the SRBC's computer system was upgraded. This left the project team with two alternatives: (1) complete the induced infiltration analysis without the groundwater flow model; or (2) reconstruct the model input files knowing there would be no budget to complete a thorough update or recalibration of the model. It was decided that the best alternative for the

participants was to reconstruct the CAAM utilizing the model input data listed in "Groundwater Flow Model of the Corning Area, New York" (Ballaron, 1988) where possible. Where specific data was not available, literature values for aquifer characteristics and professional judgment were used to establish parameters essential to the model. Then, the reconstructed CAAM was used to evaluate the groundwater levels and potential induced infiltration on a regional scale. It is important to note that the CAAM was developed and designed to make assessments on regional groundwater flow issues (such as basin recharge and estimated ground water level under drought conditions). The CAAM was not structured to make accurate assessments on the impact that pumping from an individual production well would have on a local scale (village or town). To make these type of assessments, the CAAM would have to be updated and recalibrated as discussed in section 6.4 in this report.

Model input information not directly listed in the 1988 model report, such as stream stage at river nodes or the top and bottom of geologic units, was estimated based on data presented in the report. Therefore, the reconstructed CAAM resembled the 1988 model presented in the above-referenced modeling report as much as possible.

6.2 RECONSTRUCTION OF CAAM

The CAAM was reconstructed utilizing the same underling assumptions and boundary conditions outlined in the above-referenced modeling report. The modeled area is shown on Figure 6-1. As in 1988, MODFLOW was utilized to develop the quasi-three-dimensional, two-layer groundwater flow model for the Corning area. MODFLOW requires that the area under investigation be divided into discrete subareas (nodes), and that the finite-difference approximation of a differential equation be solved for each node for a specified boundary condition and aquifer hydraulic property. The reconstructed model utilized the same model grid spacing as the published model, a matrix of 27 rows (extending north-south) and 48 columns (extending east-west) with a uniform grid spacing of 500 feet by 500 feet (Figure 6-1).

In general, natural hydrogeologic boundaries define the extent of the stratified drift aquifer system in the Corning area. These boundaries include: (1) the contact between stratified drift and till or bedrock valley walls on the north and south sides of the valley; (2) the top of the aquifer as defined by the water table which moves up and down seasonally, depending on the balance of hydrologic stresses acting on the aquifer; and (3) the bottom of the aquifer as defined

by the contact between highly permeable sands and gravel and the less permeable till and/or bedrock below.

The boundary between the stratified drift aquifer and valley walls is simulated in the model in two ways. Where the upland areas adjacent to the aquifer are not drained by discrete stream channels, the valley wall contact is treated as a specific-flux boundary. Where the upland areas adjacent to the aquifer are drained by discrete streams, hydraulic interaction with the aquifer is simulated as a head-dependent flux boundary with the river package in MODFLOW. The eastern and western model boundaries were selected to represent the rate at which water enters or leaves the active part of the model grid. These boundaries were also simulated as head-dependent fluxes.

The top boundary of the aquifer is the water table and is treated in the model as a free-surface recharge boundary. Recharge from precipitation is applied uniformly to each cell in Layer 1 of the model grid. The water table can move up and down, depending on the balance of stresses in the model area. The contact between the bottom of the stratified drift and adjacent bedrock is assumed to be a no flow boundary in the model because of the large permeability contrast between the two formations. The bottom of the aquifer was defined by data presented in "Groundwater Flow Model of The Corning Area, New York" (Ballaron, 1988).

Five surface water bodies were incorporated into the groundwater flow model: Chemung River, Cohocton River, Tioga River, Cutler Creek, and Post Creek. As in 1988, the surface water bodies were simulated utilizing the river package in MODFLOW.

For model calibration purposes, the model inputs such as direct recharge, storage coefficients, and groundwater withdrawal rates were identical to the values listed in the modeling report. Other model inputs, such as horizontal hydraulic conductivity in Layer 1, transmissivity in Layer 2, and VCONT (the variable used to control the vertical leakage between model layers), were obtained from distribution plots (that show the range of the model input values in the study area). Model input parameters, such as aquifer thickness, upland recharge from till and bedrock, stream bed vertical conductivity, and river stages, were recalculated using the data provided in the 1988 report.

A. **Verification of CAAM.** Before a groundwater flow model can be used (for even the most basic analysis), it must first be demonstrated that the model can accurately simulate the

groundwater system in question. This is done by calibrating the model. The model calibration procedure is a process of adjusting the aquifer parameters (hydraulic conductivity, storage coefficient, etc.) and stresses (direct recharge, upland underflow, etc.) to produce the best match between simulated and observed water levels and flows. The 1988 version of the CAAM (CAAM88) was calibrated to both an average steady-state pumping condition and transient conditions. The CAAM88 model calibration is discussed in detail in the 1988 model report (Ballaron, 1988).

Because of budget constraints, the revised version of the CAAM (CAAM02) could not be calibrated using the method described above. Therefore, an alternative, more cost-effective means was needed to ensure that the CAAM02 simulated the groundwater flow in the study area reasonably well. The CAAM02 simulated results from the steady-state calibration described in the 1988 report were compared to the published results generated using the CAAM88. Although the two models are somewhat different, because of the assumptions necessary to reconstruct the CAAM, the goal of the calibration procedure was to obtain simulated results from the CAAM02 are comparable to the calibrated CAAM88 results.

If the results from the two model simulations were similar, it is reasonable to conclude that the CAAM02 is capable of simulating the groundwater system in the Corning area, and thus can be used to evaluate the induced infiltration under drought conditions. It was demonstrated in Ballaron's 1988 modeling report that the CAAM88 was able to simulate the aquifer system reasonably well.

The orientation of the water table, the water level elevation in the monitoring wells, and the model mass balance were used as the basis of comparison between the CAAM02 and the published results. The CAAM02 would only be deemed usable if all three of these items matched the published results reasonably well. Several model simulations of CAAM02 were needed to produce results similar to the published results. Initially, the simulations using CAAM02 showed that the orientation of the water table and the groundwater gradient near Painted Post did not match the field data. To address this, model parameters not explicitly listed in the 1988 report (horizontal and vertical hydraulic conductivity, stream stages and streambed leakage) were adjusted (within the ranges outlined in the 1988 report) until the results from the CAAM02 matched the published results reasonably well.

Figure 6-2 is a plot showing a comparison of the simulated groundwater table surfaces generated by the CAAM02 and the published results generated by CAAM88. The figure shows a very good correlation between the two water table maps, with the only minor difference between the two maps occurring in an area where stream stage elevation and stream bottom permeability data were not explicitly listed in the modeling report.

Table 6-1 compares simulated water level elevation from the CAAM02 to that of the CAAM88 and observed water level elevation from the 1986 calendar year. The table shows that 79 percent of the simulated CAAM02 water levels are within 2 feet of the published model data, and that 90 percent of the CAAM02 water levels are within 5 feet of the published model data. These data illustrate that the simulated water level elevation from the CAAM02 matches the published data reasonably well. Table 6-1 also shows that the simulated CAAM02 data match the observed data in a similar fashion as the CAAM88 data; locations with the greatest discrepancy between the observed and simulated water level elevations were similar for both the CAAM88 and CAAM02 simulations. In addition, the absolute residual mean between the observed water level elevation and the CAAM02 and the CAAM88 water level elevations was 4.15 feet and 3.23 feet, respectively. The variance is well within acceptable limits for regional simulations. Figure 6.3 is a plot showing the location of each of the monitoring locations or calibration targets used to compare the CAAM02 to the CAAM88.

The mass balance between sources and discharges was also compared to ensure that the CAAM02 maintained the same water balance as the CAAM88 simulation. The comparison (Table 6-2) shows that the two mass balances are very similar. The total flows for CAAM02 and CAAM88 models were 18.1 and 18.9 cfs, respectively. In addition, the inflows from the rivers were 8.05 and 8.02 cfs for CAAM02 and CAAM88, respectively.

The comparison of the CAAM02 simulated results from the steady-state calibration simulation described above to the published CAAM88 simulated results showed that the CAAM02 matched the CAAM88 reasonably well. This favorable comparison shows that the CAAM02 can be used to evaluate regional groundwater levels and induced infiltration under drought conditions.

6.3 SIMULATION SETUP

Two model simulations were used to evaluate the impacts that withdrawals have on the Corning Aquifer during drought conditions. Initially, the CAAM02 model was run to steady state with

average recharge and an average withdrawal rate of 10.2 mgd (1980 withdrawal rate). The model inputs, withdrawal rates, and other boundary conditions for this simulation are identical to model data shown in the published report and utilized for the model verification analysis. The pumping rate values were not adjusted because historical data show that withdrawal from the aquifer has dropped since 1980. The average annual withdrawal in 2000 was 6.8 mgd, with an estimated maximum withdrawal of 10.0 mgd.

The resulting water levels from the average pumping, average condition model simulation reflect typical conditions in the aquifer. These levels were used as the starting condition of a 180-day drought simulation. For the drought simulation, areal recharge was removed and the underflow recharge from the till-covered highlands was reduced by 30 percent. The reduction in the rate of underflow from the till-covered highlands during the drought condition was estimated by comparing the average annual precipitation data to precipitation expected during a 1-year-in-30 drought or 3.3 percent probability of recurrence (the LBG standard defining a severe drought).

Recent records from the Corning rain gage indicate that the average annual precipitation (1972-2001) for the area is 35.2 inches (Figure 7-1). Figure 7-1 shows that precipitation during a 1-year-in-30 drought decreases to about 25.1 inches, or about 71 percent of the average annual precipitation for the study area.

River stages in the Chemung River, Tioga River, and Cohocton River were reduced by 2 feet for the 180-day drought simulation. The stage reductions were estimated using data from the Chemung River stream gage in Corning, New York. The reduction in stream stage was estimated by calculating average annual stage over the period of record (1974-2002) and the stage at 7Q10. 7Q10 is the river flow that occurs once in 10 years for 7 consecutive days. The average annual discharge for the Corning gage is 2,135 cfs; this flow corresponds to a stage of approximately 16.25 feet. The 7Q10 discharge was 86 cfs (Samide, 2002); this flow corresponds to a stage of 14.25 feet. This represents a stage decline of 2 feet, or 12 percent. A 12 percent reduction in stream stage also was used for Cutler Creek and Post Creek.

The stream bed conductances of all of the surface water bodies were reduced by 49 percent to account for changes in stream width as stream stage and discharge decreased. The reduction in conductance was estimated using published USGS gaging data for the Chemung River stream gage in Corning. The stream widths for the average annual discharge (2,135 cfs) and 7Q10

discharge (86 cfs) were estimated to be 350 and 170 feet, respectively. This represents a decline of 49 percent in width.

6.4 RECOMMENDED UPDATES

As presently constructed, the CAAM developed in 2002 and calibrated to concur with the SRBC model of 1988 is of sufficient complexity to provide general information on how the aquifer system functions at a regional scale. This model will provide an excellent framework for future area-specific (town, village, city) models and hydrogeologic investigations. The existing CAAM02 can readily be expanded as more funds and data permit.

If the CAAM is to be used in the future to evaluate management alternatives (such as well spacing) to assess the effect of pumping on river stage and discharge or to delineate recharge areas of production wells, the model will need to be updated and additional hydrogeologic data will need to be collected. The recommended model updates fall into two general categories: structural changes and updates to incorporate features that have been added to MODFLOW since the CAAM was originally developed in 1988.

A. **Recommended Structural Updates to CAAM.** One structural change recommended for the CAAM model is the refinement of the model grid spacing. Refinement of model grid is necessary to simulate the cone of depressions and velocity fields around the production wells with enough accuracy so that the model results can be used as input for particle tracking and/or solute transport programs. The use of a particle tracking and/or solute transport program is very important when trying to accurately map well capture zones in aquifers, such as the Corning Aquifer, that have semi-confining layers that impact the horizontal and vertical flow field in the aquifer. Particle tracking and/or solute transport programs allow the modeler to visually observe where water particles go and what causes them to move (taking into account the effects of rivers, boundaries and confining units) and to identify the source of water which feeds into each production well. This analysis is essential to the identification of wellhead protection strategies and for the location of monitoring wells as early warning detectors of pollutants.

A second structural change recommended for the CAAM is the modification of how the semi-confining units are simulated in the model. Currently, the semi-confining units are not simulated directly in the model. These layers are simulated using only a leakage term to represent the flow between model layers. The leakage term takes into account the thickness and vertical hydraulic

conductivity of the confining unit. Although using a leakage term to represent the semi-confining units is a viable and reasonable approach, it is recommended that these semi-confining units be simulated directly in the CAAM so that contaminant transport programs can more readily be used.

Another recommended structural change to the CAAM is the modification of how Layer 2 is simulated in the model; Layer 2 should be changed from a confined layer to a confined/unconfined layer. A confined/unconfined layer uses a storage coefficient input parameter when the potentiometric water level elevation is above the top of the layer and a specific yield parameter when the water level drops below the top of the layer (the unconfined aquifer conditions). When the potentiometric water level drops below the top of the layer, the layer thickness, and thus the transmissivity, is recalculated using the water level elevation and the bottom of layer elevation. This recommended change would allow for more accurate model simulations during drought simulations.

Another structural change recommended for the CAAM is to expand the simulated area to include more of the Tioga and Cohocton River basins to the west and north and more of the Chemung River basin to the east. This expansion will allow the model to be used to evaluate management alternatives within a larger portion of the study area. Other less radical structural changes include adjusting the model to incorporate geologic boring data, pumping test data, water level data, and production well withdrawal data that were developed after 1988.

B. **CAAM Updates Related to Changes in Modeling Technology.** The second general category that the recommendations fall under is technological updates. This category includes the recommendations made to incorporate features that have been added to MODFLOW since the CAAM was originally developed in 1988. The first of these recommendations is to recalibrate the model to a steady state and to transient conditions using an automated parameter estimation code. Parameter estimation codes are computer programs that use nonlinear regression to make calibration more efficient and objective because parameter values are adjusted automatically using linear regression to obtain the best possible match between simulated and observed stream flows and water level values. Use of such codes provide information on parameter sensitivity and helps quantify the effect of uncertainty in parameter values, making the simulated model results more technically defensible. In addition, a predictive sensitivity analysis should be performed to further quantify the effect of uncertainty in parameter values.

Another recommendation that falls under the technological updates category is to use MODFLOW's stream package STR1 (Prudic, 1989) instead of the river package. STR1 allows flow values to be entered, tracking of flow through the stream, and allows the stream or river to go dry during simulations. The use of the STR1 allows the model to simulate the interaction between groundwater and surface water in a much more realistic manner, especially when simulating drought conditions. As the model is currently constructed, the river package continues to add recharge to the aquifer even when a stream should be dry.

Another package that has been added to MODFLOW, recommended for use in the CAAM, is the Variable-Recharge package (Kontis, 2001). This package is used to gain an understanding of how topography and precipitation impact the distribution of recharge to the stratified drift deposits in the valley and estimate the amount of mean annual runoff that becomes groundwater recharge from the upland area. The package accounts for channeled and/or unchanneled surface runoff and lateral groundwater flow to the stratified drift.

In addition, optimization programs, such as Remax or MODFOC, should be utilized to develop operational guidance for municipal and industrial water users. The premise behind optimization programs is very simple; the groundwater flow model (in this case, MODFLOW) is run with a list of constraints (such as stream leakage, drawdown, pumping rate) that must be met. If not all of the constraints are met, the pumping rates of simulated production wells are increased or decreased. This process of adjustment completes when all the criteria are met.

C. **Hydrogeologic Data Needed to Update CAAM.** Numerous hydrogeologic investigations have been completed in the study area. These studies have provided extensive data in the area, such as well completion, pumping tests, geologic logs, stream discharges, groundwater elevations, and precipitation data. In the past, this information was used to develop the above-mentioned groundwater flow model. Even with this extensive database, additional information is needed to further refine and calibrate the CAAM so that the model can be used to evaluate management alternatives (i.e., which wells to operate to minimize impact) and assess the effect of pumping on river stage and discharge in the rivers.

It has been determined that in order to recalibrate the CAAM to a level in which the model can be used to assess management alternatives, the relationship between the rivers and the aquifer needs to be better defined. With this as the goal, the recommended data collection in the study

area would consist of re-establishing the region-wide groundwater level monitoring network, installing stream bed piezometers, conducting stream bed permeability tests, and stream gaging.

If it has not already been implemented, the region-wide groundwater level monitoring network should be re-established. Data from this network would be used to prepare water table and potentiometric surface maps and to document the aquifer's response to seasonal variation in recharge and withdrawals. The monitoring frequency of the network should be monthly. These data would also provide the information needed to recalibrate the CAAM to a transient condition (i.e., seasonal fluctuations). Transient model calibration is necessary to show that the groundwater flow model is capable of making future predictions.

To document the magnitude and direction of the vertical flow between the aquifer and the river under different flow regimes and withdrawal levels, and to monitor the stage of the surface water bodies, it is recommended that stream bed piezometers be installed in the Chemung River, Cohocton River, Tioga River, Cutler Creek, and Post Creek. Data obtained from the piezometers will be used to document stage changes for transient model recalibration and aid in the recalibration of stream bed leakage. The piezometers should be monitored at the same frequency (monthly) as the monitoring well network.

Because the stream bed leakage from each of the surface water bodies is an important recharge source to the aquifer, in-situ falling head tests should be performed at several locations in the Chemung River, Cohocton River, Tioga River, Cutler Creek, and Post Creek. The tests need to be performed to ensure that the vertical hydraulic conductivities used during model development and calibration are realistic. Stream gaging should also be completed at each of the tributaries to better define infiltration along stream reaches and provide additional data for model recalibration.

D. **Recommended CAAM Update Discussion.** When the CAAM has been refined to include the recommended structural and technological updates and sufficient new data have been collected to refine model calibration, management alternatives can be evaluated. The results from this evaluation can be used to develop a region-wide operations plan. The updated CAAM model can also be used to delineate wellhead protection areas and identify wells located in high risk areas. The more detailed model will be capable of predicting the route traveled by water particles entering the zone of influence for critical wells. Using this information, a series of monitoring wells can be installed to test for pollutants before they reach the production wells. In

a highly industrialized area, this type of analyses and the establishment of an early warning system is important to purveyors of potable water.

TABLE 6-1

OBSERVED VERSUS SIMULATED GROUNDWATER ELEVATION FOR AVERAGE STEADY-STATE SIMULATION USING WATER LEVEL ELEVATIONS FROM 1986

Well	Observed Water Elevations (ft msl)	CAAM02 Model Simulated Water Elevation (ft msl)	CAAM88 Model Simulated Water Elevation (ft msl)	Residual Between CAAM02 and CAAM88 (feet)
SRB-4	909.18	909.06	908.67	-0.39
SRB-1	907.90	909.23	908.09	-1.14
SRB-3	909.03	909.27	908.77	-0.50
SRB-2	909.07	909.31	908.59	-0.72
SRB-5	910.10	912.71	912.56	-0.15
SRB-44	909.00	908.97	907.80	-1.17
CC4	907.00	909.20	908.65	-0.55
CC5	904.00	909.11	908.43	-0.68
CC8	907.00	908.74	910.18	1.44
42-21	909.49	909.52	909.36	-0.16
31-13	909.05	909.40	908.83	-0.57
SRB-6	910.84	900.00	910.69	10.69
SRB-7	909.25	910.15	910.55	0.40
SRB-43	910.00	910.52	910.07	-0.45
SRB-8	909.54	909.51	909.43	-0.08
SRB-10	909.32	908.51	910.09	1.58
SRB-11	909.90	910.93	911.62	0.69
SRB41	909.46	907.79	908.82	1.03
SRB-12	909.65	908.05	909.54	1.49
CG-E	903.24	907.11	908.79	1.68
CGB	876.00	906.98	908.42	1.44
CG-C	890.00	907.36	908.27	0.91
SRB-13	907.94	911.91	913.19	1.28
SRB-14	934.91	935.04	934.10	-0.94
SRB-42	926.80	934.71	931.93	-2.78
SRB-15	964.04	947.12	966.10	18.98

TABLE 6-1 (Continued):

Well	Observed Water Elevations (ft msl)	CAAM02 Model Simulated Water Elevation (ft msl)	CAAM88 Model Simulated Water Elevation (ft msl)	Residual Between CAAM02 and CAAM88 (feet)
SRB-16	919.17	919.17	919.84	0.67
SRB-17	911.77	914.36	914.39	0.03
SRB-18	911.47	914.37	913.78	-0.59
SRB-19	919.00	917.93	919.71	1.78
SRB-20	924.69	924.17	927.23	3.06
SRB-21	920.97	921.46	920.95	-0.51
SRB-39	914.22	914.06	915.27	1.21
SRB-22	912.05	917.19	916.94	-0.25
SRB-23	932.89	938.27	934.28	-3.99
SRB-26	950.26	948.29	950.55	2.26
SRB-27	935.35	946.30	946.47	0.17
CC-1	910.35	913.63	915.57	1.94
CC-2	901.96	913.67	914.71	1.04
CC-7	911.00	908.24	908.86	0.62
CC-9	903.00	905.42	906.85	1.43
SRB-24	919.21	920.49	920.94	0.45
SRB-25	927.68	926.33	923.29	-3.04
SRB-38	927.19	923.95	921.80	-2.15
SRB-29	949.71	936.55	941.81	5.26
SRB-28	954.52	896.00	954.52	58.52
SRB-30	925.46	924.44	924.72	0.28
SRB-31	927.06	929.36	928.09	-1.27
SRB-32	927.06	926.76	927.32	0.56
SRB-33	926.98	926.60	927.33	0.73
SRB-36	926.93	926.72	927.86	1.14
SRB-37	924.67	900.00	926.08	26.08

TABLE 6-2

MODEL-GENERATED WATER BUDGET FOR STEADY-STATE CONDITIONS BASED ON AVERAGE ANNUAL HYDRAULIC DATA

	Cubic Feet Per Day			Cubic Feet Per Second			Million Gallons Per Day			Percent of Withdrawal From Recharge Source (%)
	Inflows	Outflow	Difference	Inflows	Outflow	Difference	Inflows	Outflow	Difference	
CAAM02 Model, Steady-State Average Condition, Withdrawal Rate at 10.13 mgd										
Withdrawals Wells	0	1,353,800	-1,353,800	0.000	15.669	-15.669	0.000	10.127	-10.127	---
Recharge From Upland Till and Precipitation	675,080	0	675,080	7.813	0.000	7.813	5.050	0.000	5.050	49.87
River Leakage	695,190	149,410	545,780	8.046	1.729	6.317	5.200	1.118	4.083	40.31
Underflow From Stratified Drift	194,110	61,284	132,826	2.247	0.709	1.537	1.452	0.458	0.994	9.81
Total	**1,564,380**	**1,564,494**	**-114**	**18.106**	**18.108**	**-0.001**	**11.702**	**11.703**	**-0.001**	
CAAM88 Model, Steady-State Average Condition, Withdrawal Rate at 10.13 mgd										
Withdrawals wells	0	1,367,300	-1,367,300	0.000	15.825	-15.825	0.000	10.228	-10.228	---
Recharge From Upland Till and Precipitation	655,600	0	655,600	7.588	0.000	7.588	4.904	0.000	4.904	48.43
River Leakage	692,770	150,732	542,038	8.018	1.745	6.274	5.182	1.128	4.055	40.04
Underflow From Stratified Drift	282,040	113,010	169,030	3.264	1.308	1.956	2.110	0.845	1.264	12.49
Total	**1,630,410**	**1,631,042**	**-632**	**18.870**	**18.878**	**-0.007**	**12.196**	**12.201**	**-0.005**	

CHAPTER 7

SUSTAINABLE YIELD

The objective of sustainable long term-yield analysis may be best described by Meinzer (1923), who defined sustainable long-term yield as "The rate at which water can be withdrawn from an aquifer for human use without depleting the supply to the extent that the withdrawal at this rate is no longer economically feasible." The economic considerations that govern the rate that ground water can be withdrawn from an aquifer are primarily the costs associated with lower regional ground-water levels. Some of those costs associated with increasing aquifer withdrawal are:

- The need to deepen wells or install larger pumps in existing wells.
- Additional power costs resulting from larger drawdowns in wells.
- Most importantly, the need to install more and more production wells spaced throughout the region in order to withdrawal the desired amount of water. In the case of a large developed aquifer, such as the Corning area aquifer, the location and number of wells are limited based on land use and the ability to safely and economically develop a well network (source, treatment, and connection to distribution).

The definition of sustainable long-term yield has been further expanded through the years. Fetter (1988) defined the sustainable yield to be the "amount of naturally occurring ground-water that can be economically and legally withdrawn from an aquifer on a sustained basis without impairing the native ground-water quality or creating an undesirable effect such as environmental damage." Determination of sustainable yield is a much more difficult task than defining it. Before a determination of long-term yield can be made, recharge sources must be identified and quantified.

7.1 SOURCES OF RECHARGE

Recharge is generally related to precipitation, but the amount of rainfall that becomes groundwater recharge is difficult to measure directly. In the Corning area, the average precipitation is about 35 inches per year (1972-2001). About half this amount is lost to

evaporation and transpiration processes; the remainder is available to become surface water and groundwater runoff. Groundwater recharge results from the portion of total rainfall and snowmelt that infiltrates the soil and overburden materials within the area of potential recharge. If groundwater is not removed by wells, the recharge eventually discharges to surface water and becomes groundwater runoff.

The area of potential recharge to the Corning aquifer was determined using surface topography, where the recharge area boundaries were delineated up to the watershed boundaries in the till. The groundwater divides were assumed coincidental with surface water drainage divides. The major sources of recharge to the stratified drift underlying Corning within the area of potential recharge are:

- precipitation that falls directly on the surface of the aquifer
- groundwater flow from surrounding hills
- most importantly, infiltration from streams and rivers, which occurs when wells depress the level of the groundwater table below that stream level

A. **Direct Recharge to the Stratified Drift Deposits.** The annual volume of recharge from precipitation to the surficial aquifer depends upon two factors: the extent of the coarse-grained materials and the annual precipitation rate. Recharge to the aquifer under "normal" recharge conditions is estimated to range from 6 to 6.8 mgd. This value was derived by multiplying the estimated direct recharge area (7.5 square miles) by an estimated average recharge for the area that ranges from 0.8 million gallons a day per square mile (mgd/mi^2) to 0.9 mgd/mi^2 (MacNish and Randall, 1982).

Because precipitation is a major recharge source, the rate at which the groundwater system is recharged is dependent upon the rate of precipitation accumulation. Figure 7-1 shows the precipitation record available for the Corning rain gage (Cooperative Identification No. 301787). The figure indicates that the average precipitation in recent years at the Corning gage (1972-2001) is 35.15 inches per year and precipitation during a 1-year-in-30 drought is about 25.1 inches, or about 71 percent of the average annual average. If groundwater recharge decreases at the same rate as precipitation during periods of diminished rainfall, the recharge estimated will be reduced by about 29 percent during a 1-year-in-30 drought. Therefore, the

recharge directly to the stratified drift from precipitation under "drought" conditions is estimated to range from 4.3 to 4.8 mgd. These values were derived using the same methodology used above, with the exception of the estimated average recharge rate which was decreased by 29 percent (to 0.59 and 0.64 mgd/ mi^2) to reflect a 1-year-in-30 drought.

B. **Recharge From Upland Hillsides Adjacent to Aquifer.** "Recharge resulting from lateral ground-water inflow across the aquifer boundary is determined by delineating areas of adjacent till and bedrock upland that are not drained by streams" (Haeni, 1978). On an annual basis, the amount of groundwater inflow to the aquifer from the upland till-bedrock area will be equivalent to the estimated natural recharge to these areas.

It has been shown that areas underlain by stratified glacial deposits have a recharge rate that is 2.7 times higher, on average, than areas underlain by till (Starn et al., 2000). Based on this relationship, under "normal" recharge conditions, the estimated average recharge from the upland areas ranges from 0.30 to 0.33 mgd/mi^2. These values were calculated by dividing the direct recharge to the stratified drift (0.8 mgd/mi^2 to 0.9 mgd/mi^2, Discussed above) by 2.7 and are comparable to values presented in Ballaron (1988) and Cervione (1972) (0.34 and 0.35 mgd/mi^2, respectively) for natural recharge from the till and bedrock upland areas.

The annual volume of recharge from the adjacent till and bedrock upland areas not drained by a stream "under" normal recharge conditions is estimated to range from 3.7 to 4.1 mgd. This range of values was derived by multiplying the upland area not drained by a stream (12.4 mi^2) by an estimated average recharge rate that ranges from 0.30 to 0.33 mgd/mi^2. The estimated recharge for the adjacent till and bedrock upland areas under "drought" conditions is estimated to range from 2.6 to 2.9 mgd. These values were derived by multiplying the adjacent upland till/bedrock area not drained by a stream by an estimated recharge rate that was decreased by approximately 29 percent to reflect a 1-year-in-30 drought.

C. **Stream-Aquifer Interconnection.** The simulated model results presented by Ballaron (1988) show that under natural, non-pumping conditions, groundwater moves from the aquifer through the stream bottom deposits into the streams, i.e. a gaining stream. The model results also show that under pumping conditions, the natural water table gradient is reversed, and water from the stream will infiltrate the aquifer. The rate of induced infiltration depends on the distribution of wells, the pumping rate, the vertical and horizontal hydraulic conductivity within the aquifer and stream bed, and water temperature within said stream.

Because the Post Creek, Cutler Creek, Cohocton River, Tioga River, and Chemung River are major recharge contributors for the aquifer, the discharge in the rivers during "drought" conditions imposes an obvious limit on the amount of water that could potentially be induced through the stream beds. "Discharge in the river" means the Chemung River flow that leaves the study area. The stream flow available for induced recharge to the stratified drift aquifer is estimated to be about 46 cfs, or 30 mgd. The value was estimated by subtracting the minimum allowable flow in the Chemung River necessary to assimilate wastewater (from the downstream sewage treatment plant) from the flow equaled or exceed 95 percent of the time at the Corning stream gage.

The estimated 95 percent exceedance probability low flow value for the Chemung River at the Corning gage location is 132 cfs, or 85 mgd, for the period from 1903 through 2000. This value was calculated by completing a drainage basin reduction analysis of the data from the Chemung River gaging station located downstream of the Corning gage in Chemung, NY. Figure 7.2 is a plot of the stream discharge probability curve developed by LBG for the Corning Gaging location.

Based on communication with NYSDEC (Samide, 2002), the estimated 99 percent exceedance probability low flow value or 7-day, 10-year low flow (86 cfs, or 56 mgd) is the minimum allowable flow at the Corning stream gage necessary for wastewater assimilation. This 7Q10 flow was recalculated by NYSDEC in the mid-1990s to account for upstream storage facilities (impoundments) that were constructed in the 1970s.

Although 30 mgd of stream flow may be available for induced infiltration, it is important to note that it may not be economically feasible to withdraw the entire amount. According to MacNish and Randall (1982), "unconventional well arrays of relatively high cost might be required (for example, collector wells, vertical wells of exceptionally efficient design, and/or numerous closely spaced wells with high pumping lifts and modest individual yields)" to induce the entire available stream discharge.

The CAAM, originally developed by SRBC and reconstructed by LBG, was used to predict the volume of water that would be induced from the streams (Post Creek, Cutler Creek, Cohocton River, Tioga River, and Chemung River) during a drought. It should be understood that the groundwater flow model was utilized to provide a rough estimate of the potential induced stream bed recharge. In order to provide a more precise estimate, the CAAM needs to be refined and

updated. The recommended model refinements and updates are discussed in detail in the model discussion sections of this report (see Chapter 6).

The general simulation scheme consists of withdrawing the maximum possible amount of groundwater while infiltrating less than 30 mgd from the streams in the area. During this analysis, the individual well yields were limited to the pumping rates that result in a drawdown equal to approximately 30 percent of the initial saturated thickness of the unconfined and semi-confined aquifers. This limitation was added to the simulation to compensate for the additional drawdown that would occur under real pumping conditions because of well inefficiency and partial penetration (well not screened across entire aquifer thickness). The boundary conditions and model set up for the drought simulation are discussed in detail in Chapter 6 of this report.

An optimization program call PEST (Doherty, 1994) was utilized to aid in the evaluation of the maximum amount of groundwater that can be removed from the aquifer during a drought without adversely affecting the rivers or the aquifer. The groundwater flow model (in this case, CAAM) is run with a maximum allowable drawdown and a minimum and maximum pumping rate assigned to each production well. PEST adjusts the pumping rates of the production wells automatically, running several possible pumping combinations, until a solution is found that meets the drawdown and stream leakage limitations discussed above while maximizing the withdrawal.

Results from the analysis suggest that the aquifer approaches steady state at the end of the 180-day elevated pumping period in a drought. Simulation results also suggest that 21 mgd of groundwater could be withdrawn from the existing production well network without excessive dewatering of the aquifer or inducing more than 30 mgd from the streams. The following table compares the aquifer withdrawal rate with the predicted volume of induced infiltration during a simulated 180-day drought.

Withdrawal From Aquifer (mgd)	Predicted Induced Infiltration (mgd)	Percent of Potential Induced Infiltration
10.2	6.3	21
21.0	17	57

The table shows that at a regional withdrawal rate of 21 mgd, 17 mgd is induced from the streams and rivers in the area. Because this is less than the potential induced infiltration of 30 mgd, 17 mgd was used as the maximum potential induced stream bed recharge for this analysis. As discussed, a larger percentage of the available surface water could potentially be induced through the stream bed if a more extensive production well network were installed and withdrawal rates were optimized (utilizing a refined and recalibrated groundwater flow model) to limit adverse impacts to the streams and aquifer. Utilizing a refined and recalibrated groundwater model, operational guidelines for well use that would further increase the allowable withdrawal rate during an extreme drought could be developed.

Note that under extremely dry conditions, smaller quantities (less than 30 mgd) of stream flow would be available for long periods. During these dry periods, it may be necessary to decrease groundwater withdrawals from the aquifer to prevent the Chemung River flow from decreasing below 86 cfs at Corning, the minimum flow needed for wastewater assimilation. For example, results from the CAAM drought simulation show that at a regional withdrawal rate of 10.2 mgd (a value greater than the present and projected 2010 pumping levels), the predicted volume of water infiltrating through the stream beds is estimated to be 6.3 mgd (or 9.8 cfs). Based on this prediction, it would be necessary to decrease regional pumping rates in the aquifer if the average daily stream flow at the Chemung River stream gage in Corning declined below 96 cfs for a period of seven days.

As stated in section 6 of this report, the CAAM was developed to provide an assessment of regional ground water flow and the potential yield of the aquifer. The CAAM is not able, as currently constructed, to make accurate assessments of potential well yield on a local scale without further refinement.

If the CAAM is not refined and both the existing and potential well locations are not added, the site specific resulting analysis provides results of only limited value. For example, following table shows the total increase in withdrawal from the 1980 rates presented in Ballaron (1988) to the predicted maximum withdrawal rates for the pumping centers located in Erwin, Painted Post and Corning.

Area	Withdrawal Rate From 1980 Pumping Centers (mgd)	Maximum Sustainable Withdrawal From 1980 Pumping Centers (Drought) (mgd)	Percent of Total Increase
Erwin	0.6	1.7	10.2
Painted Post	1.9	5.4	32.4
Corning	7.7	13.9	57.4
Total	**10.2**	**21.0**	--

The table shows that when utilizing the pumping centers presented in Ballaron (1988) (shown on Figure 6.1) the Corning region accounts for most of the predicted increase in withdrawal and that there is limited potential for expansion in Erwin. Obviously, if the pumping centers were located in different areas or if addition pumping centers were added to the system, the percent of the total increased for each of the regions and the potential for expansion in Erwin would change drastically. Therefore, as stated above, to obtained meaningful data on the sustainable yield on a local level, it will be necessary to expand the model to include all existing wells in addition to the location of any new potential wells in a refined CAAM for analysis.

7.2 SUSTAINABLE YIELD

The estimated yield of the aquifer is equal to the recharge from direct precipitation (4.3 to 4.8 mgd) plus the recharge from the upland till areas (2.6 to 2.9 mgd) plus the water that could potentially be induced from the surface water bodies. The volume of water that could potentially be induced from the rivers and creeks that overlie the aquifer under "drought" conditions is estimated to be 26 cfs, or 17 mgd. Thus, the maximum yield of the aquifer during "drought" conditions is estimated to range between 23.9 and 24.7 mgd.

According to MacNish and Randall (1982), to maintain an annual withdrawal rate of 25 mgd over a six-year drought, such as that of the 1960s, twice the volume pumped (or 18.25 billion gallons) would have to be available in subsurface storage. The total storage of the aquifer based on data presented in MacNish and Randall (1982) is 15.8 billion gallons. Therefore, "a smaller rate of withdrawal that could be sustained during a severe drought from the available storage" was calculated using the method outlined in MacNish. The results from this analysis indicate that the maximum sustainable yield of the aquifer in the Corning area is about 19.5 mgd.

Note that this analysis did not take into account water quality (potential or existing groundwater contamination) or other factors that may limit the quantity of potable groundwater during a drought. Because of this, an expansion of the existing aquifer protection program is recommended. As part of this expansion, sources of known and potential groundwater contamination would be identified and mapped, and the updated and revised CAAM would be used to accurately map the recharge areas of the existing and potential production wells so that the resource can be protected in the future.

CHAPTER 8

DROUGHT MANAGEMENT

8.1 INTRODUCTION

Periodic drought is a normal, recurrent feature of virtually every climate and can have severe impacts on people, the economy, and the environment. Drought planning is an important proactive action taken by the government, industry, and public in predicting water shortages and establishing remedies to minimize the effects of those shortages. Planning helps to minimize the impacts, conflicts, and severity of water shortages.

Drought can often be mitigated through the early recognition of a drought situation, coupled with a mechanism for balancing of water demand with water supply. This is typically accomplished through implementation of a water conservation program. The purpose of this drought management plan is to provide the Chemung River Valley community (the Town of Erwin, the City of Corning, the Town of Corning, the Village of Painted Post, and the Village of Riverside), with an effective means of assessing drought conditions; providing programs to reduce the risk of advanced drought; and providing the appropriate response to drought that will minimize economic, environmental, and social stress.

This chapter discusses the procedures used for the establishment of the Drought Management Plan that is included as Appendix A. This plan was developed in conjunction with the Steering Committee after consideration of the "stakeholders" concerns and comments. The plan identifies:

- Jurisdiction - What area is covered by plan
- Administration - Members, duties, responsibilities, and decision making
- Drought Stages - Definitions and action levels (triggers)
- Responses to various drought stages
- Consequences for non-compliance

The intent of the Steering Committee was to develop a drought management plan that would be adopted and implemented by all Team members. Since the communities involved are all

neighbors drawing from the same aquifer, the goal was for all participating municipalities jointly to declare drought stages and to take unified action in response to drought.

8.2 DROUGHT DEFINITIONS

Drought is defined as a significant deficit in moisture availability due to lower-than-normal precipitation. This lack of moisture continues for sufficient duration to "affect plant and animal life of a region and to deplete domestic and industrial water supplies" (Ponce, 1989). However, there are many different ways to define drought. Drought is generally defined based on the type of drought occurring. There are four commonly used drought definitions:

1. A meteorological drought is a significant deviation from normal precipitation conditions over a period of time for a specific region. Since the definition is based on the number of days of precipitation less than some average expected amount, meteorological drought only applies to regions with seasonal rainfall patterns.

2. Agricultural drought is a deficiency of soil moisture needed for a particular crop over a specific time period. Precipitation shortages, soil water deficits, and reduced groundwater and reservoir levels characterize agricultural drought. Greatly depleted crop yields can result from rainfall shortages during critical periods of the growth cycle.

3. Hydrological drought refers to deficiencies in surface and subsurface water supplies. A hydrological drought is the effect that periods of low precipitation have on the hydrologic system as a whole. It is measured in terms of stream flow, lake and reservoir levels, and groundwater levels.

4. Socioeconomic drought occurs when the water supplies are so low that they negatively affect the community where the drought is occurring. It is based on the demand for economic goods that rely on water, such as drinking water supplies, recreational fishing, hydroelectric power, food processing, or other industrial uses.

New York State defines drought in terms of meteorological/hydrological drought and agricultural drought. The State Drought Index is based on meteorological and hydrological characteristics. It compares five parameters against historic values to evaluate drought: stream flow, precipitation, lake and reservoir storage levels, and groundwater levels. To evaluate

agricultural drought, the state uses the Palmer Drought Index. The Palmer Drought Index is a measure of soil moisture computed by the National Weather Service. The New York State Department of Environmental Conservation (NYSDEC) collects and monitors data for both the State Drought Index and Palmer Drought Index for nine drought management regions, based on drainage basins and county lines (NYSDEC, 2002). The State Drought Management Task Force coordinates state drought response and also assists communities in drought management.

The Susquehanna River Basin Commission (SRBC) is an independent agency created by a compact between Maryland, New York, Pennsylvania, and the federal government for the planning, conservation, management, development, and control of the water resources in the Susquehanna River Basin. The Chemung River Valley is part of the Susquehanna River Basin, and therefore under the Commission's authority. The SRBC defines drought as hydro-meteorological and uses six parameters to evaluate and monitor drought: precipitation, groundwater level, stream flow, the Palmer Drought Index, the storage levels of key water supply reservoirs, and reported public water supply problems. The levels of these parameters used by the SRBC to trigger drought are more stringent than those defined by NYSDEC.

For the Chemung River Valley, drought will be defined primarily as hydro-meteorological as well. The precipitation deficit and the flow of the Chemung River will be the primary drought indicators for the study area. Analysis of long-term precipitation and river flow records for the Corning Area and comparison of those records to the drought impacts over the last 40 years led to the selection of precipitation and stream flow as the critical drought parameters for the water supply in the valley. The selection of these two parameters was reaffirmed based on drought simulations using the ground water flow model (CAAM02). Much emphasis on drought in the valley will be dependent on the level of the Chemung River since during drought conditions, aquifer recharge is significantly affected by river stage.

8.3 ADMINISTRATION

Drought monitoring and drought management in the Chemung River Valley will be coordinated through a Drought Management Team. The Steering Committee established the membership of that team to include a representative from each community involved, a representative from the Department of Health (NYSDOH), and a representative from the Steuben County Emergency Management Office. In addition to the five communities participating in this study, the Steering Committee has invited the Villages of Addison and South Corning to be standing members of the

Drought Management Team. The communities and the NYSDOH will each select their representative. The person chosen from each of the communities should be someone designated to make decisions for that community, since responsibilities of the management team will include deciding the drought status for the valley's water supply and implementing conservation measures dictated by the Drought Management Plan (Appendix A). The members of the team should be appointed for multi-year terms that expire at staggered times to maintain a consistency of knowledge within the committee; only one person will be designated from each entity and those persons will be responsible for attending all meetings.

One member of the Drought Management Team will serve as the chairperson, who will be responsible for coordinating meetings and data collection. The chairperson will serve as a facilitator/mediator for discussions and conflict resolution among team members. The position of chairperson will be rotated on an annual basis.

All decisions made by the Drought Management Team will be made by consensus. All members will generally agree on and be required to support decisions made by the Drought Management Team. The standing members of the Drought Management Team will be responsible for meeting twice a year, or more often during dry seasons, to review and discuss the status of the water supply.

The responsibilities of the Drought Management Team were reviewed with and adopted by the Steering Committee. Those responsibilities include:

- attendance at all meetings
- collecting groundwater level data from their communities and from local commercial/industrial supplies
- deciding on the status of drought conditions
- initiating community-wide responses to various drought levels
- providing agencies (NYSDOH, NYSDEC, SRBC, county agencies) with local data
- determining the role of local and/or state government in drought response for the valley
- discussing concerns caused by drought: industrial roles, affects on tourism and conflicts that could result
- determining the needs of primary users (hospitals, fire departments, nursing homes)
- acting as liaison between Drought Management Team and the governing bodies of the various communities (i.e., city council and town/village boards)

Various "stakeholders" with significant interest in a reliable water supply will be informal members of the Drought Management Team. These informal members will be kept informed of drought status and drought conditions, but will not make decisions on drought conditions. A stakeholder can be any entity that is a large water user whose operation will be significantly affected by drought conditions. Stakeholders include NYCDEC, Three Rivers Development Corp., STCRPDB, SRBC, Corning County Club, Dresser Rand, World Kitchen, Corning, Inc., Indian Hills Golf Club, and Pollio, Inc. Stakeholders will be invited to meetings as necessary and as decided on by the Drought Management Team.

Although the Drought Management Team will be responsible for making decisions for the area, they are still under the jurisdiction of both the NYSDEC and SRBC. In New York State, the NYSDEC is the lead agency on drought management; however, local water purveyors within New York State are charged with the management of resources for their community. The water purveyors implement restrictions on non-essential water uses according to the Drought Management Plan; these restrictions are implemented through local laws and/or ordinances and enforced through local water departments in conjunction with their police departments. The Susquehanna River Basin Drought Coordination Plan (Runkle, 2000) states that it is the Commission's responsibility to develop and effectuate water resources plans, policies, and projects; and to adopt, promote, and coordinate policies and standards for water resources conservation, control, utilization, and management. SRBC can also respond to a drought emergency by modifying existing permits for water withdrawal and consumptive use.

8.4 DROUGHT STAGES

The SRBC uses a three-stage system to define the severity of a drought: (1) drought watch; (2) drought warning; and (3) drought emergency, in order of increasing severity. As explained in the Susquehanna River Basin Drought Coordination Plan (Runkle, 2000), the SRBC can only make a drought declaration after agreement and discussion with the affected states. As stated previously, the New York State Drought Management Task Force coordinates state drought response and assists communities in drought management. A fourth stage, drought disaster, does exist in the New York State Drought Plan. This stage provides a mechanism to receive federal "disaster" aid to help relieve the hardship of drought. The Governor must declare a drought disaster in order for the area to be eligible for federal disaster funds.

The Chemung River Valley project team, including the Steering Committee, selected a drought management plan with four stages: watch, warning, emergency, and disaster. Those stages are described further in this chapter and in the Drought Management Plan (Appendix A).

A. **Drought Watch.** A drought watch is the least severe of the four drought stages. A drought watch is declared when a drought is developing and conditions indicate a potential water shortage if precipitation trends continue. As stated in the Susquehanna River Basin Drought Coordination Plan, a drought watch is intended to give advanced notice of a developing drought event. During this stage, local communities should urge customers and industry to voluntarily reduce water demand by 5 to 10 percent.

For the Chemung River Valley, a drought watch is declared solely based on precipitation levels. In order to select the appropriate precipitation levels to trigger the various drought stages, 53 years of precipitation records (National Climatological Data Center, 2002) were analyzed. These analyses of 6- and 12-month running deficits were compared to the Steering Committee's perception of stressed water supply conditions over the last 15 years. It was critical that the declaration of a drought warning would have significance to the customer. There was concern that if a drought watch were declared too often (say every year), the public would ignore the Drought Management Plan. The triggers that were selected were:

Duration of Deficit (Months)	Precipitation: % Below Normal
6	25
12	15

Based on these triggers, a drought watch would have been declared 18 times over the 53 years of record. Table A-1, Precipitation Deficit, Six-Month Running Average, and Table A-2, 12-Month Precipitation Deficit (Appendix A), list percentage deficits for various month durations. Historic precipitation at the Corning, NY rain gage is shown in Table 8-1.

TABLE 8-1

CRITICAL PRECIPITATION
Cooperative I.D. Gage No. 301787

	PRECIPITATION (INCHES)												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Monthly Average	2.0	1.7	2.9	3.1	3.5	3.5	3.6	3.5	3.2	2.7	2.7	2.2	34.6

Close monitoring of precipitation and stream level of the Chemung River should follow the declaration of a drought watch to determine if conservation efforts alleviated the stress put on water resources or if the drought condition has worsened to a drought warning.

Table A-3 of the Drought Management Plan summarizes drought triggers for each stage and identifies conditions that permit rescinding of drought stage.

B. **Drought Warning.** A drought warning is declared when there are measurable or visible signs that water supplies are lower than normal and diminishing. This stage is an indication of impending and imminent severe drought conditions, as stated in the Susquehanna River Basin Drought Coordination Plan. The plan suggests increasing public awareness of the impending drought conditions and increasing voluntary conservation to achieve a 10 to 15 percent reduction in water demand.

As with drought warning, the determination of the triggers for a drought watch in the Chemung River Valley was made after an analysis of precipitation records at Corning. The project team was also interested in maintaining continuity with the SRBC's Drought Management Plan. Based on the review of historical precipitation, the triggers for a warning were established as:

Duration of Deficit (Months)	Precipitation: % Below Normal
6	30
12	20

Based on these triggers, there would have been 15 drought warnings in the Corning area over the 53 years of local precipitation records.

Table A-3 of the Drought Management Plan summarizes drought triggers for each stage and identifies conditions that permit rescinding of drought stage.

C. **Drought Emergency.** When the capacity of the water resource is clearly inadequate to meet demand, a drought emergency should be declared. There are two aspects of water resources that are of concern to the Drought Management Team as the drought situation worsens:

1. The condition where there is inadequate water supply to meet the communities' needs.

2. When there is inadequate flow in the river to provide assimilative capacity for wastewater discharges.

The groundwater flow model (CAAM02) demonstrated that during drought conditions, a high percentage of the flow withdrawn by wells was induced from the river system (Chemung, Cohocton, and Tioga). Therefore, river flow was established as an additional trigger for declaration of a drought emergency. Precipitation deficit was retained as a trigger. Either precipitation or river flow will activate a drought emergency. For precipitation, the triggers were established as:

Duration of Deficit (Months)	Precipitation: % Below Normal
6	40
12	30

For the Drought Management Plan, the flow records in the Chemung River were analyzed. Since the USGS stream flow gage at Corning only has records since 1975, a drainage basin analysis was used to correct the stream flow data available for the Chemung River at Chemung gage (97 years of record) to an estimate of flows at Corning. A probability distribution analysis (Figure 7-2) of the data indicated that at a low flow condition that occurs only 5 percent of the time (severe drought), the average daily flow in the Chemung River would be 132 cfs. Therefore, the trigger for drought emergency was set when average daily flow in the river at Corning is less than or equal to 132 cfs. Based on this criteria, there would have been three drought emergencies in the 97 years of flow records; the most recently emergency would have been in 1965.

During a drought emergency, the management team will implement mandatory restrictions on all non-essential water uses. Local police departments will be used to enforce these restrictions through local laws and water use ordinances. The goal of the restrictions is to reduce the overall water demand by 20 percent. The mandatory conservation measures are described in the Drought Management Plan (Appendix A).

Table A-3 of the Drought Management Plan summarizes drought triggers for each stage and identifies conditions that permit rescinding of drought stage.

D. **Drought Disaster.** A drought disaster is declared when water supplies are unable to meet the essential water needs of the constituents within the drainage area. The situation is extremely serious and the Drought Management Team must dictate which essential uses must be curtailed. All public health-related needs will be maintained.

Two criteria were selected as triggers for declaration of a drought disaster:

1. **River Flow.** Based on a probability distribution of average daily flow in the Chemung River at Corning, a flow of 100 cfs is exceeded 99 percent of the time. Therefore, a flow of 100 cfs or less occurs only 1 percent of the time (extreme drought). A disaster stage is declared when the river flow falls below 100 cfs for five consecutive days. .

2. **Municipal Well Levels.** When the drawdown in a number of municipal wells drops the pumping level to within 2 feet of the pump intake. Since there is currently no database on well levels, the appropriate number of wells required to activate a "disaster" should be selected after at least one year of data is collected on all active municipal wells. It is anticipated that a total of three or four wells in multiple communities (i.e., two wells in the City of Corning and one in Painted Post) will trigger a disaster.

Drought stages do not have to be declared or retracted in consecutive order. If the drought situation rapidly or abruptly changes, a stage may be skipped. The purpose of the drought triggers and drought monitoring is to lessen the possibility of an advanced drought condition occurring before any proper warning of drought is known. The multiple stages provide sufficient warning to allow proper planning. For all four stages, it is very important to keep the local media and public aware of current drought status and definitions of those stages.

Table A-3 of the Drought Management Plan summarizes drought triggers for each stage and identifies conditions that permit rescinding of drought stage.

8.5 RESPONSE TO DROUGHT STAGES

Once monitoring indicates that one of the drought stages exists, the Drought Management Team must proactively take steps to minimize the consequences of a prolonged dry period. Early action and the development of a conservation mind-set among the customers can significantly reduce the effects of drought.

The following responses for the various drought stages were taken from a variety of conservation resources, including the American Water Works Association, Susquehanna River Basin Drought Coordination Plan, and New York City's Drought Management Plan and Rules.

A. **Drought Watch.**

1. Request voluntary conservation of water. The goal of a drought watch is to decrease water demands by 5 to 10 percent. Inform the public through the newspaper, radio, and/or television of various water conservation tips. A list of sample conservation tips is included as Appendix A, Drought Management Plan. Chapter 9 stresses the importance of a water conservation plan.

2. Inform the NYSDEC, NYSDOH, and SRBC of the drought status.

3. Expand on existing leak detection, repair, and hydrant surveillance programs.

4. Budget for future financial resources to be used in the event of an escalation of drought conditions.

5. Monitor and record precipitation, Chemung River levels, and well levels for evidence of change.

6. Urge large water users (i.e., Corning Inc., World Kitchen, Inc., Pollio, Inc., Dresser-Rand Inc. golf courses) to reduce non-essential water use.

7. Rescind drought as condition improves.

B. **Drought Warning.**

1. Reiterate the request for voluntary conservation of water. The goal of a drought watch is to decrease water demands by 10 to 15 percent. Inform the public through the newspaper, radio, and/or television of various water conservation tips. A list of sample conservation tips is included in Appendix A.

2. Mail a list of conservation tips to each customer along with the normal water bill.

3. Inform the NYSDEC, NYSDOH, and SRBC of the drought status.

4. Continue to monitor precipitation, Chemung River stream levels, and well levels for indication of change.

5. The Drought Management Team should meet monthly to discuss the current drought status.

6. Rescind drought stage as conditions improve.

C. **Drought Emergency.**

1. Require mandatory conservation of water. Restrict all non-essential water uses. The goal of a drought emergency is to decrease water demands by 20 percent. Inform the public through the newspaper, radio, and/or television of various water conservation tips and of the drought status.

2. Inform the NYSDEC, NYSDOH, and SRBC of the drought status.

3. Consider alternative water sources. Inventory industrial water use to determine if emergency supplies are available.

4. Actively involve stakeholders in meetings of Drought Management Team.

5. The Drought Management Team should meet more frequently to discuss impacts of conservation measures on water supplies. Identify options to alleviate stress on the water supply.

6. Prohibit non-essential water uses, such as lawn watering, car washing (see complete list of suggested water restrictions in Appendix A).

7. Enforce mandatory conservation measures through local laws and water use ordinances. Charge and fine violators in accordance with Drought Management Plan (Exhibit A).

8. Rescind drought stage as conditions improve.

D. **Drought Disaster.**

1. Reissue public notice in newspaper and announce new drought status on local television.

2. Require mandatory conservation measures. Restrict all non-essential and some essential water uses. The goal of a drought disaster is to reduce water use by 25 percent. Enforce conservation measures using local law enforcement; charge and fine constituents for violations.

3. Inform the NYSDEC, NYSDOH, and SRBC of new status. Ask NYSDOH to keep Governor's office appraised of situation.

4. Meet with stakeholders; industry must reduce use in accordance with Appendix A.

5. Implement shutdown of business and institutional uses as shown in Exhibit A.

6. Rescind drought stage as conditions improve.

8.6 DROUGHT MANAGEMENT PLAN

The Drought Management Plan was developed in an outline form as a standard operating procedure. The plan is included in Appendix A. The plan identifies specific drought triggers and conservation responses to the various drought stages. Table A-3 identifies the triggers both for declaration and rescinding of the various stages.

CHAPTER 9

WATER CONSERVATION

9.1 INTRODUCTION

Water conservation measures are activities which lead to the reduction in water demands and, consequently, the need for the associated water production. Most purveyors of water implement water conservation measures only when supplies are in danger of running short. Once the urgency of the crisis has subsided, the requirement to utilize water conservation measures is lifted. For most northeastern communities, conservation measures are for emergency use only and remain in effect only for the duration of that emergency. Water customers see the Northeast as being rich in water, with no need to conserve on a regular basis. Therefore, most purveyors constantly balance between the need to conserve and the need to sell water to generate revenue.

9.2 LOCAL CONSERVATION MEASURES

In the summer of 1999, the Chemung River Valley experienced drought conditions which brought conservation measures to the forefront. A variety of conservation measures are available to influence both long- and short-term consumption trends. These methods available to reduce water consumption are:

A. **Metered Water Service**. The first step in controlling customers' water use is to bill for service based on quantity of water consumed. In order to accomplish this, water meters must be installed and maintained on all services. All purveyors in this study area currently require meters on customers' services. However, it is critical that aging meters be replaced so that an accurate accounting of water use can be developed. Each community should implement a water meter replacement program such that meters older than 15 years are replaced.

B. **Rate Structure Encouraging Conservation**. Historically, communities in the water-rich Northeast have implemented declining rate structures that encourage growth and give an economic benefit to the larger users (i.e., industrial and large commercial users). In recent years, it has been more and more common to utilize flat or inclining rate structures to discourage increased consumption; this is particularly true as water consumption approaches the capacity of

a community's source of supply. The Towns of Erwin and Corning and the Village of Riverside have flat rate structures, and the City of Corning and Village of Painted Post have declining rate structures. During droughts when it is important to conserve water, purveyors could switch to an alternate inclining structure. The problem with switching rate structures during dry periods is that customers have not budgeted for the change and there will be controversy.

C. **Water Use Restrictions**. Water use restrictions are typically imposed under drought conditions. Typically, these restrictions either limit the uses for which water can be drawn or limit the times in which certain water use can take place. Examples of non-essential water uses include outside consumption, such as lawn and garden watering, fountain and pool use, and car washing. Examples of essential uses that may need to be curtailed during extreme drought conditions (drought disaster) include commercial car washing, irrigation, street sweeping, school activities, and some commercial and industrial activities.

D. **Low Flow Fixtures**. Current building codes require that new construction utilize low flow fixtures, such as toilets and shower heads. However, most buildings that existed before 1980 were equipped with conventional fixtures that do not restrict flow. A means of reducing consumption is to encourage retrofitting of existing buildings with low flow plumbing fixtures.

E. **Water Audits**. A detailed water audit conducted by the purveyor of water can develop and document trends in water use. Through closely monitoring consumption and analyzing flow records, communities can develop a better appreciation for where their water is being used. Not only do such audits identify the various components of water use within a given service area, but they also document trends in consumption, thereby enabling communities to identify potential problems and areas to target for conservation. The initial audit establishes a baseline for comparison to industry trends and for comparison to the results of future year audits. Knowing a system's water use components enables a purveyor to better forecast future system demands, thus enabling the purveyor to plan for growth and establish the sources of supply necessary to meet that growth. Each community currently collects data on metered production and consumption that can be used to complete a water audit.

F. **Leak Investigations**. In its most basic form, a water audit compares the metered water at the customer's tap to the produced water and establishes a component identified as "unaccounted-for" water. Unexplained increases in unaccounted-for water point to the need for a leak detection survey. Leak detection contractors are available to identify leaks and provide an

estimate of the magnitude of those leaks. If a community prefers, equipment is commercially available to perform leak surveys with municipal employees.

G. **Education Programs.** Education can make the customers aware of the importance of water, limitations on the source of supply, severity of drought conditions, and the importance of conservation measures. During a drought watch and warning, it is critical that the Steering Committee frequently alert the public to the need for conservation by voluntary or mandatory means, or rationing may even become necessary. The public has a short memory and drought notices require constant reinforcement.

During the preparation of the Drought Management Plan, the Steering Committee invited all stakeholders to a meeting to provide input on practical conservation measures. It was clear from industries' responses that certain manufacturing processes cannot be interrupted. The Steering Committee must continue to work with the stakeholders during non-drought periods to develop conservation measures that can be implemented as effective water saving techniques during drought periods. Appendix C includes public information facts on water conservation. This information should be provided to the public as the drought progresses.

1. **Press Releases.** The first method of notifying your customers of a drought condition should be through the media. Press releases and interviews can provide basic information that starts the conservation process.

2. **Billing Inserts.** Brief inserts in the customers' quarterly bill can be used to reinforce the severity of a drought and remind customers of measures they can take to help alleviate the drought situation. Generic pamphlets on water use and water conservation, designed as billing inserts, are available from the American Water Works Association bookstore (www.AWWA.org).

3. **School Education.** Education of children who convey the information to their parents can be an effective tool in disseminating drought information.

4. **Public Meetings.** As drought conditions become more severe, public meetings can be used to reach a limited audience face to face. However, public meetings generally attract press coverage (television, radio, and newspapers) that dramatically expands the size of the audience.

9.3 ESTABLISHING A WATER CONSERVATION PROGRAM

The NYSDEC is charged with permitting all new sources of drinking water supply in New York State (both municipal and industrial). A new supply or an expansion of an existing supply must receive a water supply permit which must be accompanied by a water conservation plan. These water conservation plans force purveyors to review their current and future water use and to evaluate their existing procedures for reducing the need for increased water production. While the water conservation plan can be as basic as completing the form provided by NYSDEC, it does force even the smallest community to assess the state of their water system and to consider alternate and/or more innovative ways to operate their systems. The basic framework provided by NYSDEC can be expanded into a more detailed water conservation plan. NYSDOH requires that all purveyors of water have an emergency water plan. This document should cross reference the community's water conservation plan.

The development of a water conservation plan could be a stand-alone project for the Chemung River Valley water purveyors that could be prepared and implemented concurrent with the adoption of a drought management plan. The implementation of the plan can be relatively painless and could result in a reduced need for capacity. The American Water Works Association's publication, *Water Conservation,"* identifies the basic philosophy and major components of conservation and has an excellent reference list for developing a water conservation program.

Water conservation programs can be divided into long- and short-term activities that promote conservation measures. Long-term measures are designed to reduce the overall annual water consumption of the community. This may be accomplished by enacting year-round conservation measures or through the use of seasonal conservation to reduce the peaks in water consumption. Since all sources of supply and treatment facilities must be designed to meet the maximum daily demand, it can be extremely beneficial to a purveyor to reduce the seasonal peak consumption. Short-term conservation measures are designed to reduce consumption during emergency conditions. Examples of this include malfunction of major equipment or response to a drought condition.

Water conservation programs should include development of a written conservation plan that addresses both the long- and short-term conservation issues. The American Water Works

Association (AWWA) has a library of references that cater to the drinking water industry. Five of those references that are particularly valuable in developing a conservation program are:

1. *Water Conservation* (AWWA, 1987).
2. *Drought Management Planning* (AWWA, 1992).
3. *Water Audits and Leak Detection - AWWA Manual M36* (AWWA, 1999).
4. *Water Rate Structures and Pricing - AWWA Manual M34* (AWWA, 1999).
5. *Water Rates and Related Charges AWWA Manual 26* (AWWA, 1996).

These references discuss not only the establishment of conservation plans in their entirety, but also the specific components that are essential to a well crafted and implementable plan.

The above references, coupled with the NYSDEC's guidelines for a conservation plan (see Appendix C), identify numerous water conservation methods and potential means of implementing a conservation program that is effective in both the short and long term. During the preparation of the Drought Management Plan, the Steering Committee developed a list of conservation measures to be implemented during the various drought phases. These conservation measures are included in the Drought Management Plan (Appendix A).

CHAPTER 10

CONCLUSIONS AND RECOMMENDATIONS

10.1 CONCLUSIONS

Based on data collected and analyzed over the past year, this water study was developed in conjunction with the project team. The results were reviewed with the team and their comments were incorporated in the text where appropriate. The following conclusions were drawn from this study:

1. The service area for this study included the City of Corning; Villages of Painted Post, Riverside, and South Corning; and the portions of the Towns of Erwin and Corning served with municipal water.

2. The current (year 2000) and projected (2012) population of the service area is 20,700 and 21,200, respectively.

3. The current and projected (2012) average daily water use for municipal customers is 3.2 mgd for both; for industrial users, the average daily water use is estimated to be 3.6 and 4.0 mgd for year 2000 and 2012, respectively.

4. The total average daily aquifer withdrawal is estimated to be 6.8 mgd for the year 2000 and projected to be 7.2 mgd for 2012.

5. Each of the five communities participating in the study is located along the Chemung River system and operates at similar hydraulic gradients. This makes the individual distribution systems good candidates for interconnection and regionalization.

6. The following conclusions were developed concerning the economic advantages of jointly procuring equipment, materials, services, and labor.

    a. Due to the minimal amount of treatment required for the well supplies in the area, minor quantities of chemicals are used by the communities as a whole;

therefore, no appreciable savings would be realized throughout the joint purchase of chemicals.

b. With the exception of the city, the communities rely on interdepartmental purchases (insurance, equipment, and construction vehicles) and interdepartmental sharing of personnel. Water, Sewer, Highway, and Public Works Departments share resources to reduce overall costs.

c. With the existing administrative structure (five independent and separately controlled water departments), there is only limited opportunity to reduce costs through the pooling of resources. The only operational activity with potential for appreciable cost savings is the sharing of personnel. The overall staff size could be reduced if the operations and maintenance staffs could be consolidated (annual Water Department savings of $50,000 to $130,000).

7. Six administrative structures were compared and reviewed with the Steering Committee. The committee selected two options for comparison: independent operation (status quo) with intermunicipal agreements for cooperation, and development of a regional water authority.

8. With the current trend of increased regulatory requirements and public scrutiny of water systems, the water resources of the valley can best be managed by the formation of a regional authority that focuses only on the supply of water to the valley's customers. However, this structure requires the individual municipalities to relinquish control of their individual systems. The primary advantage of the authority is that it creates an entity that is more removed from political pressure than municipalities are and that entity is solely dedicated to water supply issues.

9. An alternate but less satisfactory structure is the use of intermunicipal agreements to foster cooperation among the valley's water systems. These arrangements offer less flexibility and will be more difficult to manage and to make equitable than the authority structure.

10. The groundwater flow model (CAAM88) developed in 1988 for the Chemung River Valley is no longer available.

11. A groundwater flow model (CAAM02) has been reconstructed similar to the model SRBC developed in 1988. That model provides a framework that can be expanded and refined in future projects.

12. Based on the groundwater model (CAAM02) and the river's hydraulic constraints, the sustainable long-term yield of the aquifer in the modeled area (see Figure 6-1) is estimated to be 19.5 mgd.

13. During sustained drought conditions, the wells within the valley are recharged primarily from the river system. At a total withdrawal from the aquifer of 10.2 mgd, 6.3 mgd of infiltration is induced from the river.

14. In its current form, the CAAM02 is sufficiently complex to provide information on how the aquifer functions on a regional scale. However, it is not calibrated to an extent that allows for area-specific evaluation; the base model can be expanded to be used for site-specific yield analysis and flow direction analysis when additional data and funds become available.

15. During this project, an implementable Drought Management Plan was developed for the Chemung River Valley. The plan describes the four stages of drought and provides the drought indicators (triggers) that activate each stage. Conservation measures responding to each stage are recommended. The plan was endorsed by the Steering Committee and reviewed with the stakeholders.

10.2 RECOMMENDATIONS

Based on the evaluations performed during this study and meetings with the Chemung River Valley Water Steering Committee over the past year, recommendations that involve plan implementation and future planning activities have been developed. These recommendations are:

1. Since the Steering Committee provides an excellent forum for discussion of water-related issues and selection of courses of action, this committee should continue to meet on a bi-monthly basis.

2. Each Steering Committee member should discuss this water report with the municipal decision makers.

3. Each governing board should adopt the Drought Management Plan as developed and appoint a member to the Drought Management Team. Each board must:

a. Agree to act in unison with the participating entities.

b. Develop and approve local laws and/or water ordinances that empower the Drought Management Team with the powers identified in the drought plan. The law must provide the mechanism for declaring drought stages, empower the team with the authority to establish responses to drought, and identify consequences for constituents that fail to comply with the law.

c. Retain an attorney to prepare this legislation.

4. The Steering Committee should continue to evaluate the regional approach to water supply for the valley. The proximity of the various systems to each other makes the area a prime candidate for a centralized system.

5. The technical and financial advantages of a regional water authority should be reviewed with the governing body for each participating community.

6. Establish a task force representing the six water purveyors in the Corning area. The task force should continue to assess the potential for consolidation and select the administrative structure that best serves the water needs of the area.

7. Each community should establish a Capital Reserve Fund to finance infrastructure rehabilitation. The annual contribution to that Fund should be determined based on an assessment of the individual systems by their engineer.

8. Recommended field investigations include:

a. Re-establishing a long-term hydrogeologic monitoring network (monthly monitoring frequency) to provide data for transient model calibration.

b. Installing piezometers to document magnitude and direction of the vertical flow between the aquifer and the river under different flow regimes and withdrawal levels, and monitoring the stage of the surface water bodies. This data will also be used to recalibrate the model.

c. Conducting in-situ stream bed permeability tests to obtain a better understanding of the vertical stream bed permeabilities

d. Establishing staff gages at each of the tributaries to better define infiltration along stream reaches and provide additional data for model recalibration.

9. Seek funding to expand the groundwater flow model (CAAM02) to include the entire service area for the Town of Erwin (to the north and west) and the Town of Corning (to the east).

10. Recommended changes to the groundwater flow model are:

a. Refinement of the model grid spacing to simulate the velocity fields around pumping centers with enough accuracy to allow the particle tracking and/or solute transport programs to be used.

b. Simulate the semi-confining layer directly in the model so that particle tracking and or solute transport programs can be more readily used.

c. Change the way model Layer 2 is simulated in the model from a confined layer to a confined/unconfined layer to allow for more accurate drought simulations.

d. Expand the model-simulated area so that the model can be used to evaluate management alternatives within a larger portion of the study area.

e. Recalibrate the model to steady-state and transient conditions using an automated parameter estimation code.

f. Use of the stream package STR1 (Prudic, D.E., 1989) instead of the river package to allow for a more realistic simulation of groundwater/surface water interaction.

g. Use of the Variable-Recharge package (Kontis, 2001) to gain a better understanding of upland till runoff.

11. The updated CAAM model could be used for the following:

a Delineate more refined wellhead protection areas for the aquifer and locate wells with a high risk of becoming contaminated.

b. Develop operational guidelines for municipal and industrial water users for use during extreme drought conditions. The guidelines would be developed utilizing optimization programs such as Remax or MODFOC to maximize withdrawals, while at the same time minimizing adverse impacts to the river and aquifer.

c. Re-evaluate the sustainable yield of the aquifer.

d. Evaluate basin groundwater management issues (i.e., identify best locations for additional production wells).

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FIGURES

Figure 7.1

CHEMUNG RIVER VALLEY WATER STUDY
TOWN OF ERWIN, NEW YORK

Probability Distribution of Annual Precipitation

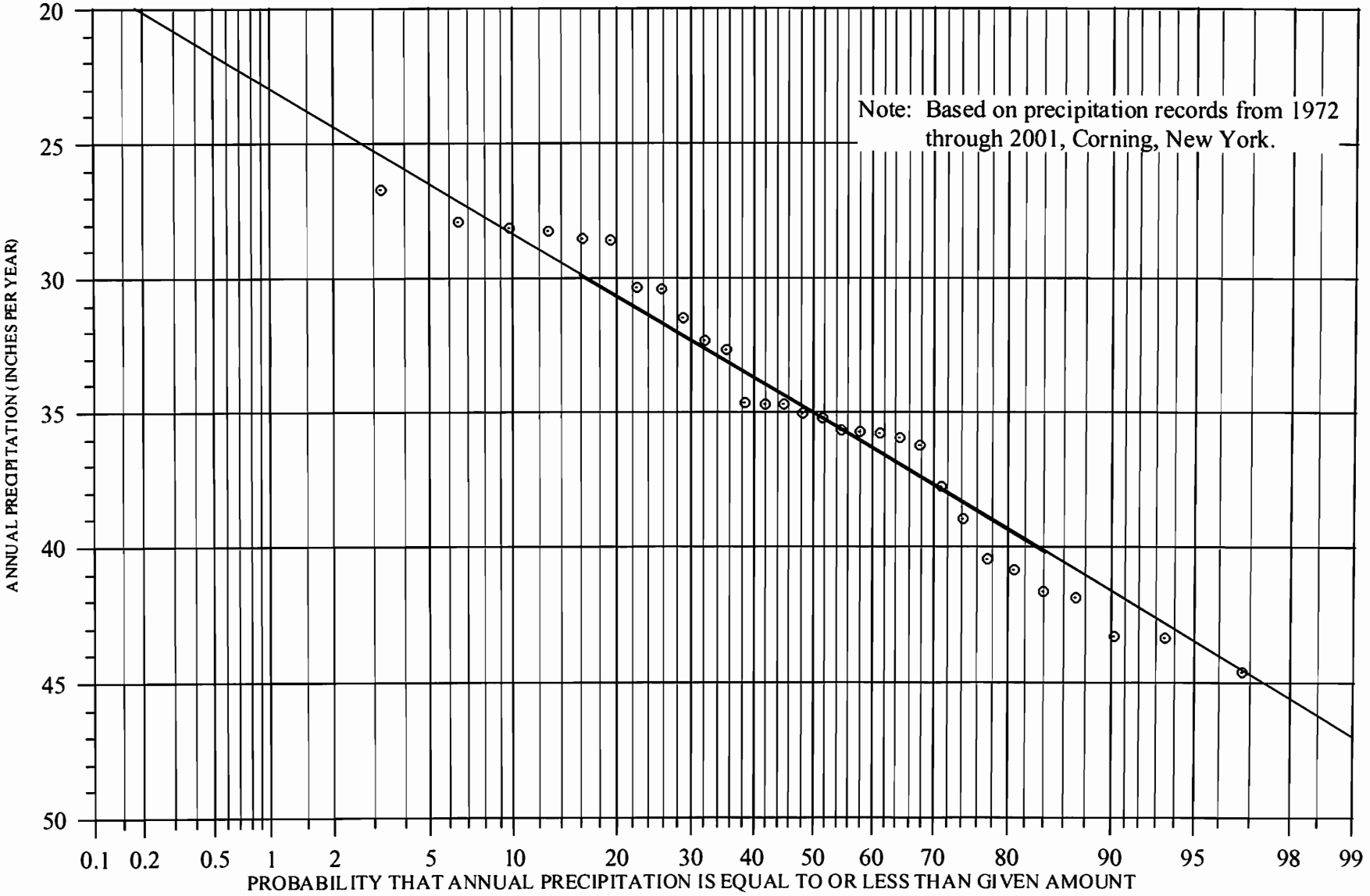
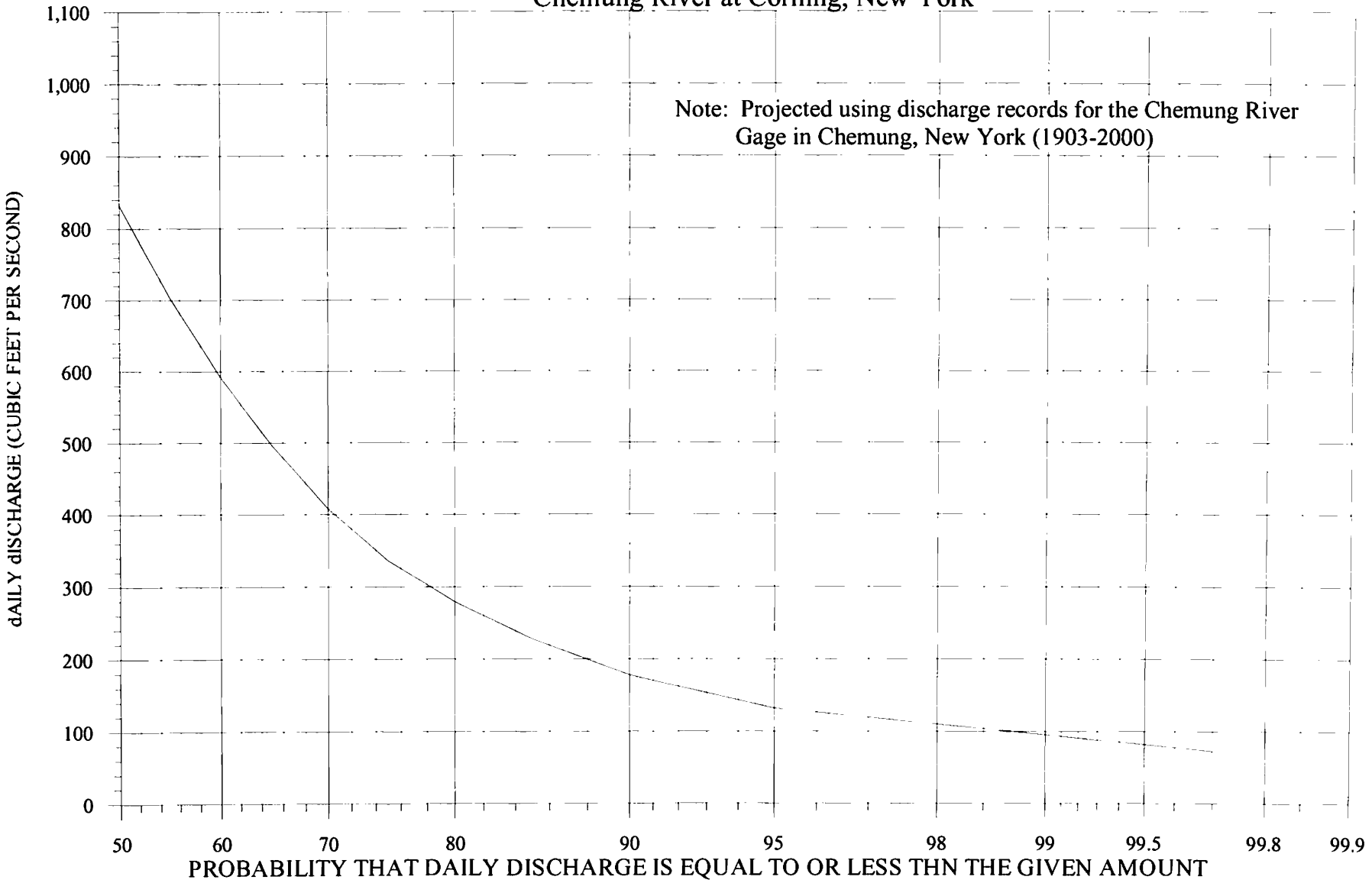


Figure 7.2

CHEMUNG RIVER VALLEY WATER STUDY
TOWN OF ERWIN, NEW YORK

Probability Distribution of Average daily Discharge for
Chemung River at Corning, New York



APPENDICES

APPENDIX A

DROUGHT MANAGEMENT PLAN

APPENDIX A

DROUGHT MANAGEMENT PLAN
GENERAL INFORMATION
CHEMUNG RIVER VALLEY

I. JURISDICTION

Boundaries of the following municipalities:

- Town of Erwin
- Village of Painted Post
- Village of Riverside
- City of Corning
- Town of Corning
- (Village of South Corning)*
- (Village of Addison)*

Plan applies to full areal extent of these municipalities and is not limited to existing municipal service areas.

*These municipalities are not members of the original study area, but will be included in the management team if they choose to participate.

II. PURPOSE

To warn constituents of drought conditions and to adopt conservation measures appropriate with the stage or level of drought that exists. Goal of drought management is to enact appropriate conservation measures in a timely manner to retain the ability of the water supply system to continue essential service to the community throughout a drought event.

III. ADMINISTRATION

A. Drought Management Team

- Team membership (voting decision-makers)
  - Town of Erwin
  - Village of Painted Post
  - Village of Riverside
  - City of Corning
  - Town of Corning
  - (Village of Addison)*
  - (Village of South Corning)*
  - New York State Department of Health
  - Steuben County Emergency Management Office
- Each entity entitled to membership will appoint one representative.

*These municipalities are not members of the original study area, but will be included in the management team if they choose to participate.

B. **Stakeholders** - Non-municipal entities with a vested interest in maintaining a reliable and continuous water supply.

- Non-voting participant during drought events.
- Each stakeholder will designate a contact person.

Stakeholders include:

Public: NYSDEC
Susquehanna River Basin Commission
Southern Tier Central Regional Planning and Development Board
Three Rivers Development Corp.

Private: Corning Country Club
Corning, Inc.
Dresser Rand
Indian Hills Golf Club
Pollio, Inc./Kraft Foods
World Kitchen, Inc.

C. **Responsibilities of Drought Management Team**

- Attend meetings.
- Collect and compile water balance (water use, precipitation, and river stage) and water table data.

  Annually: All team members and stakeholders will report monthly well pumping and groundwater levels for each well utilized. Reporting records shall be in the format required by the SRBC. This will be compiled to develop a data baseline.

  Monthly: Precipitation data (monthly total) for Corning, NY (Cooperative I.D. No. 301787)

  River flow and stage (monthly average) for Chemung River and Corning (USGS Gage No. 1529950)

  Weekly: Municipal participants will measure and record well pumping and water level so that baseline can be developed that may enable groundwater level to be used as a drought trigger in the future.

- Determination of drought stage(s); declaration of drought.
- Identify appropriate drought response.
- Educate customers concerning drought and conservation measures.
- Implement drought response(s).
- Enforce drought response.
- Rescind drought.

- Define essential uses that must be maintained throughout all drought stages: municipal (hospitals, nursing homes, extended care facilities, and domestic health-related uses); institutional (fire protection and health-related uses); and industrial (essential process and health-related uses).

- Coordinate with private stakeholders to identify and document their historical water conservation measures and the impact of process changes on water use, and to identify "essential" water uses for their facilities. Work with stakeholders to document additional water conservation measures possible during drought "emergency" and "disaster."

IV. DROUGHT STAGES

Steering Committee adopted a four-stage approach to drought levels:

- **Watch** - Advanced notice of developing drought; drought will occur if dry conditions persist.

- **Warning** - Imminent threat of severe drought; drought has begun to impact water supplies.

- **Emergency** - Dry condition has persisted for a sufficient period of time to reduce aquifer storage and well yield. Mandatory conservation measures are necessary to preserve the continued level of service for essential water supply.

- **Disaster** - Water supplies are unable to meet current demand and supplies continue to decrease. Drought is extremely serious and some essential water uses will need to be eliminated, depending on the continued severity.

A. Drought Watch

1. **Definition** - An extended period of below-normal precipitation raises concern that a continuation of the precipitation trend will result in drought. A drought watch is an advanced warning that drought could develop. The watch enables the drought management team to make the public and private constituents aware of a potential drought and the conservation measures available to counteract a water shortage.

2. Trigger for a drought watch is based on precipitation deficit as follows:

DURATION OF DEFICIT ACCUMULATION (MONTHS)	PERCENT BELOW NORMAL (%)
6	25*
12	15**

* Varies depending on month; see Table A-1, Precipitation Deficit, Six-Month Running Average.

** See Table A-2, 12-Month Precipitation Deficit. Fifteen percent (15%) is a 5-inch annual deficit.

3. **Response to Drought Watch**

a. Public notice (or press release) of drought watch in official newspaper. Include conservation tips in information package to newspaper. Notify NYSDEC, NYSDOH, and SRBC of drought watch.

b. Post notice and conservation tips in public places (municipal buildings and post offices).

c. Conservation measures are voluntary. Goal is to reduce water demands by 5 to 10 percent.

d. Suggested voluntary conservation measures during a "watch" are included in Exhibit A.

4. Rescind drought watch when six-month precipitation returns to within 10 percent of normal.

B. **Drought Warning**

1. **Definition** - Declared when extended period of below-normal precipitation begins to impact water supplies and those supplies are below normal and diminishing. There is an indication of impending and imminent severe drought conditions.

2. Trigger for drought "warning" is based on precipitation deficit as follows:

DURATION OF DEFICIT ACCUMULATION (MONTHS)	PERCENT BELOW NORMAL (%)
6	30*
12	20**

*See Table A-1.
**See Table A-2.

3. **Response to Drought Warning**

a. Public notice (or press release) of drought warning in official newspaper. Include conservation tips.

b. Post notice and conservation measures in public places (municipal buildings, post offices, schools).

c. Stress the drought status and importance of conservation with both those served by community water systems and those on private supplies.

d. Conservation measures are voluntary.

e. Suggested voluntary conservation measures during a "warning" are included in Exhibit A. The goal is to reduce water demands by 10 to 15 percent.

f. Continue to reinforce drought warning status with the constituency. Warn violators of voluntary conservation measures.

4. Rescind drought warning when six-month running average for precipitation returns to within 10 percent of normal.

C. **Drought Emergency**

1. **Definition** - Drought conditions have persisted and are occurring to such an extent as to make water supplies inadequate to meet demands. For the Chemung River Valley, this can mean either that groundwater withdrawals are inadequate to meet consumption or that as a result of withdrawal, the necessary stream flow for waste assimilation is jeopardized.

2. Trigger for a drought emergency is based on either precipitation or flow in the Chemung River at the Corning Gage (USGS Gage No. 1529950). Drought emergency triggers are:

a. **Precipitation at Corning (Cooperative I.D. 301787)**

DURATION OF DEFICIT ACCUMULATION (MONTHS)	PERCENT BELOW NORMAL (%)
6	40*
12	30**

*See Table A-1.
**See Table A-2.

b. River Flow (Average Daily) at Corning Gage (USGS Gage No. 01529950) - Average daily stream flow is less than 132 cfs for five consecutive days.

3. **Response to Drought Emergency**

a. Public notice (or press release) of drought emergency in official newspaper. Include mandated conservation measures.

b. Notify local television news stations of drought status and response measures.

c. Actively involve stakeholders in meetings of drought management team.

d. Conservation measures are mandatory. Goal of conservation is to reduce water use by 20 percent.

e. Mandatory conservation measures during a drought emergency are included in Exhibit A.

f. Industry must reduce non-essential water use (as agreed between the management team and stakeholders) by 20 percent when compared to use during the same season (three months) of the previous year, provided there was not a drought declaration in effect during that previous season.

g. Enforce mandatory conservation measures through local laws and/or water use ordinances. Steps to enforcement include:

1) Provide a single warning of violation; document complaint and warning.

2) Issue ticket(s) with a maximum fine stipulated in the water use ordinance.

3) After two tickets to the same constituent for the same infraction, threaten discontinuing water service.

4) If infraction persists, discontinue water service.

4. Rescind drought emergency when the precipitation deficit, as measured by six-month total for precipitation, returns to a level that is only 20 percent below normal for two consecutive months.

D. **Drought Disaster**

1. **Definition** - Water supplies continue to decline and are unable to meet the essential water needs of the constituents within the drainage area. Goal is to reduce water use to preserve as many essential water users as possible. As a minimum, public health needs will be considered essential.

2. Trigger for a drought emergency is based on either river flow or on pumping levels in municipal production wells. The triggers are:

a. River flow (daily average at Corning Gage) drops below 100 cfs for five consecutive days.

b. Municipal Wells Levels - The pumping level in a number of municipal wells drops to within 2 feet of the top of screen or pump intake (whichever is higher).

3. **Response to Drought Disaster**

a. Public notice (or press release) of drought disaster in official newspaper. Include mandated conservation measures.

b. Notify local television news stations of drought status and response measures.

c. Actively involve stakeholders in meetings of drought management team.

d. Conservation measures are mandatory. Goal of conservation is to reduce water use by 25 percent.

e. Mandatory conservation measures during a drought emergency are included in Exhibit A.

f. Industry must reduce non-essential water use (as agreed between the management team and stakeholders) by 25 percent when compared to use

during the same season (three months) of the previous year, provided there was not a drought declaration in effect during that previous season.

g. Implement the following shutdown of activities and businesses as necessary if the increased conservation measures fail to reverse the trend in declining groundwater levels:

- commercial car washes
- municipal swimming pools
- schools
- reduced industrial shifts/shutdown
- businesses: reduced hours or shutdown

h. Enforce mandatory conservation measures through local laws and/or water use ordinances. Steps to enforcement include:

1) Provide a single warning of violation; document complaint and warning.

2) Issue ticket(s) with a maximum fine stipulated in the water use ordinance.

3) After two tickets to the same constituent for the same infraction, threaten discontinuing water service.

4) If infraction persists, discontinue water service.

4. Rescind drought crisis when river flow for 30 consecutive days returns to 140 cfs and pumping levels in municipal wells are increasing during that same period.

TABLE A-1

PRECIPITATION DEFICIT
SIX-MONTH RUNNING AVERAGE
CORNING, NY
Cooperative I.D. Gage No. 301787

MONTH	PRECIPITATION (INCHES)					
	SIX-MONTH RUNNING AVERAGE	20 PERCENT BELOW NORMAL	25 PERCENT BELOW NORMAL	30 PERCENT BELOW NORMAL	35 PERCENT BELOW NORMAL	40 PERCENT BELOW NORMAL
January	16.3	13.0	12.2	11.4	10.6	9.8
February	14.5	11.6	10.9	10.2	9.4	8.7
March	14.2	11.4	10.7	9.9	9.2	8.5
April	14.6	11.7	11.0	10.2	9.5	8.8
May	15.4	12.3	11.6	10.8	10.0	9.2
June	16.7	13.4	12.5	11.7	10.9	10.0
July	18.3	14.6	13.7	12.8	11.9	11.0
August	20.1	16.1	15.1	14.1	13.1	12.1
September	20.4	16.3	15.3	14.3	13.3	12.2
October	20.0	16.0	15.0	14.0	13.0	12.0
November	19.2	15.6	14.4	13.4	12.5	11.5
December	17.9	14.3	13.4	12.5	11.6	10.7
TOTAL	N/A	N/A	N/A	N/A	N/A	N/A

TABLE A-2

12-MONTH PRECIPITATION DEFICIT
CORNING, NY
Cooperative I.D. Gage No. 301787

	PRECIPITATION (INCHES)						
	AVERAGE ANNUAL	15 PERCENT BELOW NORMAL	20 PERCENT BELOW NORMAL	25 PERCENT BELOW NORMAL	30 PERCENT BELOW NORMAL	35 PERCENT BELOW NORMAL	40 PERCENT BELOW NORMAL
January	2.0	1.7	1.6	1.5	1.4	1.3	1.2
February	1.7	1.4	1.4	1.3	1.2	1.1	1.0
March	2.9	2.5	2.3	2.2	2.0	1.9	1.7
April	3.1	2.6	2.5	2.3	2.2	2.0	1.9
May	3.5	3.0	2.8	2.6	2.5	2.3	2.1
June	3.5	3.0	2.8	2.6	2.5	2.3	2.1
July	3.6	3.1	2.9	2.7	2.5	2.3	2.2
August	3.5	3.0	2.8	2.6	2.5	2.3	2.1
September	3.2	2.7	2.6	2.4	2.2	2.1	1.9
October	2.7	2.3	2.2	2.0	1.9	1.8	1.6
November	2.7	2.3	2.2	2.0	1.9	1.8	1.6
December	2.2	1.9	1.8	1.7	1.5	1.4	1.3
TOTAL	34.6	29.5	27.7	26.0	24.2	22.5	20.8

TABLE A-3

SUMMARY OF DROUGHT TRIGGERS
DROUGHT MANAGEMENT PLAN
CHEMUNG RIVER VALLEY

DROUGHT STAGE	TYPE OF TRIGGER	TRIGGER LEVEL	RESCIND DROUGHT STAGE
Watch	Precipitation	25% deficit over 6-month period or 15% deficit over 12-month period	6-month precipitation returns to within 10% of normal
Warning	Precipitation	30% deficit over 6-month period or 20% deficit over 12-month period	6-month precipitation returns to within 10% of normal
Emergency	Precipitation or River level (Chemung River at Corning)	40% deficit over 6-month period or 30% deficit over 12-month period or Average monthly stream flow <132 cfs	6-month precipitation returns to 20% of normal for 2 consecutive months
Crisis	River level or Municipal production wells	Average monthly stream flow <100 cfs or Pumping water level within 5 feet of top of screen or pump intake	River flow for 30 consecutive days exceeds 140 cfs and pumping levels in wells are increasing and precipitation is normal for same period.

EXHIBIT A

CONSERVATION MEASURES FOR VARIOUS DROUGHT STAGES

WATCH - VOLUNTARY CONSERVATION MEASURES ARE IN EFFECT

- Check for leaking toilets and faucets; repair all leaks.
- Take shorter showers; take shower versus bath when possible.
- Turn faucet off when brushing teeth.
- Run washing machine and dishwasher with full load only.
- Reduce lawn watering; restrict watering to early morning and evening.
- Do not water lawns or landscaping on windy days.
- During summer months, watering of landscaping accounts for 20 to 50 percent of residential water use and provides best opportunity for water conservation at home.

WARNING - VOLUNTARY CONSERVATION MEASURES ARE IN EFFECT

Same conservation measures as for Watch. Add the following conservation measures for outside use:

- Lawn and landscape watering on alternate days based on property street address (i.e., odd parcel numbers water on odd days). Watering only permitted between 6:00 a.m. and 8:00 a.m. and 6:00 p.m. and 8:00 p.m.
- No use of fountains is permitted.
- No hydrant use permitted other than for fire protection.
- No street sweeping permitted.

EMERGENCY - MANDATORY CONSERVATION MEASURES ARE IN EFFECT

Same conservation measures as for Warning. Add the following conservation measures.

- Industries must reduce water consumption by 20 percent of their use in the three months prior to any drought declaration.
- No private car washing.
- Commercial car washes will remain open.
- No residential or commercial lawn watering.
- Golf courses may water greens only.
- Landscapers and nurseries must reduce water use by 25 percent.
- Residential pools cannot be refilled.

- Hotels/motels shall ask patrons for permissions to launder sheets at checkout (rather than daily) for multiple-day stays.
- School and municipal pools will remain open.
- Water will be served in restaurants only when specifically requested by patrons.

DISASTER - MANDATORY CONSERVATION MEASURES ARE IN EFFECT

Same conservation measures as for Drought Emergency. Add the following conservation measures:

- No watering of golf courses.
- Commercial car wash will not be permitted to operate. This includes washing of corporate, rental, and lease fleets.
- Municipal pools will be shut down.
- School will be shut down.

APPENDIX B

IDENTIFICATION OF GROUNDWATER SOURCES UNDER THE DIRECT INFLUENCE OF SURFACE WATER

NEW YORK STATE DEPARTMENT OF HEALTH	ITEM NO: PWS 42 DATE: 10/25/01
OFFICE OF PUBLIC HEALTH CENTER FOR ENVIRONMENTAL HEALTH	SUBJECT: Identification of Ground Water Sources Under the Direct Influence of Surface Water
TECHNICAL REFERENCE	Page 1 of 16

REGULATORY BACKGROUND:

The Surface Water Treatment Rule (SWTR), requirements in Subpart 5-1, Section 5-1.30, of the Sanitary Code also apply to public water systems that use a ground water source determined to be under the direct influence of surface water. Section 5-1.1 (a.a.) of Subpart 5-1 states the definition of ground water directly under the influence of surface water (GWUDI) as: "any water beneath the surface of the ground which exhibits significant and rapid shifts in water characteristics such as turbidity, temperature, conductivity or pH which closely correlates to climatological or surface water conditions and/or which contains macroorganisms, algae, large diameter (three microns or greater) pathogens or insect parts of a surface water origin."

The purpose of regulating ground water sources under the direct influence of surface water in the SWTR is to protect against contamination from large-diameter pathogens associated with surface waters. Ground water sources determined to be under the direct influence of surface water must be filtered or meet filtration avoidance criteria as contained in Section 5-1.30 of the State Sanitary Code. In some cases, it will be easier to replace the source with a properly designed and constructed well or spring, or possibly to modify the source to eliminate the direct influence of surface water. Public water systems with ground water sources under the direct influence of surface water are also subject to more stringent monitoring requirements for total coliform, turbidity, and entry point disinfection residual. The types of ground water sources potentially regulated under the SWTR include: dug wells, springs, infiltration galleries, shallow or improperly constructed wells, or other collectors in subsurface aquifers near surface waters.

The local health department (LHD) is responsible for identifying which public water sources are subject to the SWTR. However, it is the responsibility of the water supplier to provide the LHD the information needed to make this determination. The LHD is also responsible for recording and reporting the criteria used and the results of determinations. Ultimately, this information will be recorded in a SDWIS add-on, or very similar format.

All ground water sources used to supply public water systems must be evaluated for evidence of ground water under the direct influence of surface water GWUDI. This evaluation will focus on the likelihood that the ground water source could be contaminated with large-diameter pathogens, such as *Giardia lamblia* and *Cryptosporidium*, through a hydraulic connection with surface water. If a drinking water source has been identified as GWUDI, the source must meet the criteria established under the SWTR, as dictated in Section 5-1.30 of the State Sanitary Code.

OVERVIEW:

Information gathered during Sanitary Surveys, as outlined in Technical Reference PWS 180, will be important in making GWUDI determinations. In addition, information such as compliance monitoring data, topographic maps, geological reports, well logs, and data on potential contaminant source(s) gathered during vulnerability determinations (Technical Reference PWS. 72), the development of source water assessments, and/or during the implementation of watershed rules and regulations will be useful.

A two phased methodology should be used to determine whether or not a ground water source is under the direct influence of surface water.

- The Source Screening Phase is first used to separate those sources that are clearly not subject to surface water influences from those sources in need of further evaluation.
- The Detailed Evaluation Phase applies to sources identified to be tested to evaluate their degree of hydraulic connection with surface water.

There are three components of the Detailed Evaluation Phase: Hydrogeologic Assessment, Water Quality Assessment, and Microscopic Particulate Analysis (MPA). It is the water suppliers' option whether to begin the hydrogeologic or the water quality assessment portion. Both of these assessments are capable of providing the information required to determine that no surface water influence is present. However, if the results of a hydrogeologic assessment are inconclusive, a water quality assessment should be performed to complete the Detailed Evaluation. MPAs should be conducted during times which represent worst-case GWUDI conditions, as indicated by the water quality assessment.

Source Screening Phase

The Source Screening Phase should be used to separate those sources that are clearly not subject to surface water influences from those sources in need of further evaluation. A schematic of the screening procedure is presented on Figure 1, and the overall Detailed Evaluation Phase Methodology is presented on Figure 2. Box 1 (on Figure 1) includes criteria that will immediately select a ground water source for further review. These source water criteria include historical indication of GWUDI such as: a waterborne disease outbreak, chemical contamination that is thought to have originated from surface water (e.g., pesticides), and rapid fluctuations in source output, well water level, water quality (e.g., turbidity or color), and/or chlorine demand, particularly when associated with runoff events. These criteria also include the following collection device types and characteristics: springs, dug wells, infiltration galleries, cribs,

shallow horizontal underground collectors, drilled wells in carbonate aquifers, and wells within 200 feet of surface water in fractured bedrock with 100 feet or less of casing. If none of these criteria are met, then the screening process continues in Box 2.

The criteria in Box 2 asks if the source is located within 200 feet of a surface water, and/or if the well has 50 feet or less of casing. When both criteria are met, the source is selected for further review. If neither of these conditions are met, the source is designated as not being under the direct influence of surface water.

When only one of the criteria in Box 2 is met, the next step in the GWUDI determination is dependent on whether or not the water source is currently disinfected. Undisinfected wells that have met the criteria for a disinfection waiver and have an adequate coliform monitoring history (typically five years of quarterly monitoring) are to be designated as not being under the direct influence of surface water. Disinfected wells have the option of either performing one year of monthly raw water coliform monitoring or moving directly into the Detailed Evaluation Phase. Any raw water sample that is *E. coli* positive would require the system to perform a Detailed Evaluation. Conversely, once one year of satisfactory monthly raw water samples are obtained, the source can be designated as not being under the direct influence of surface water.

Figure 1: Source Screening Phase Methodology

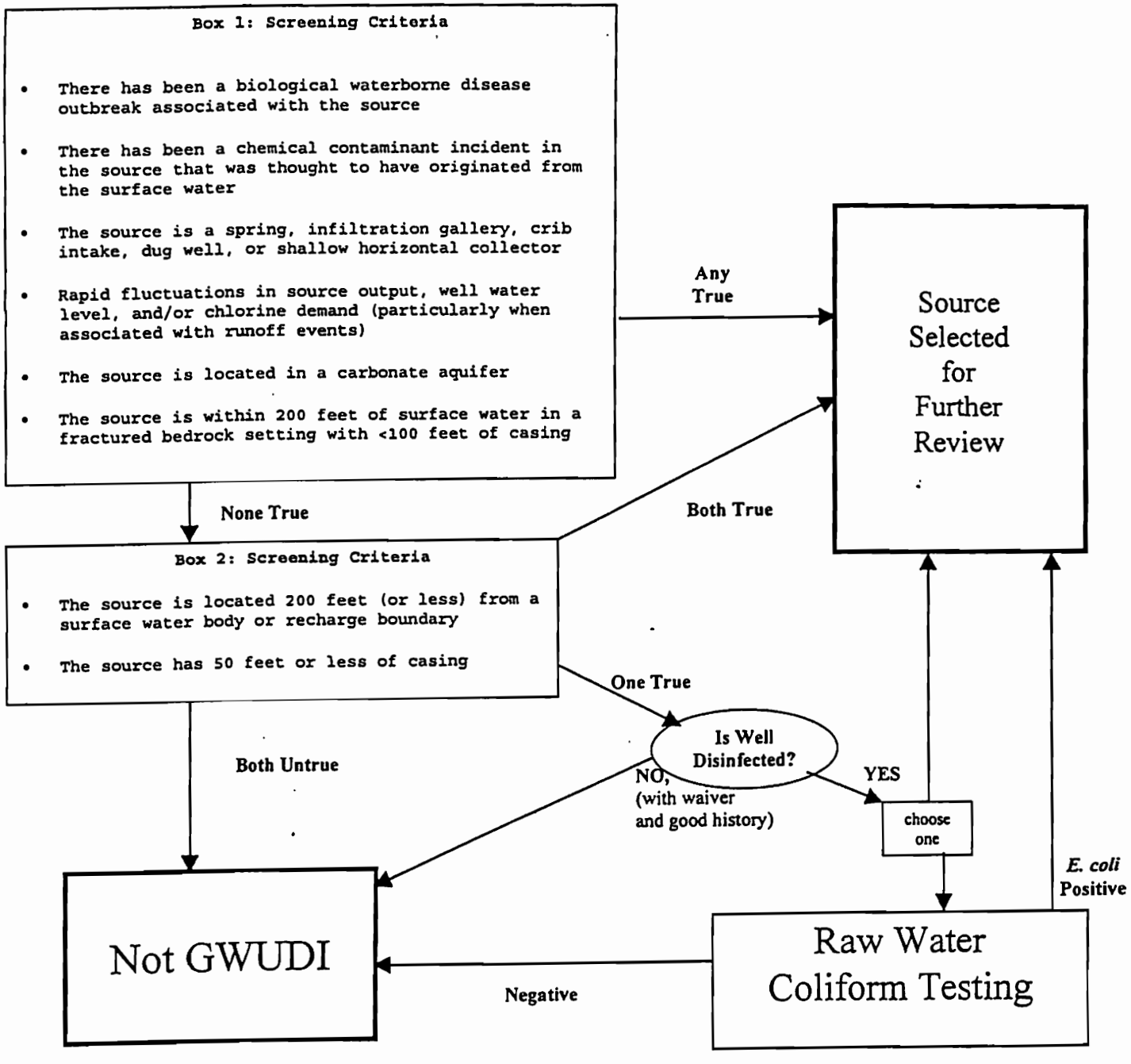
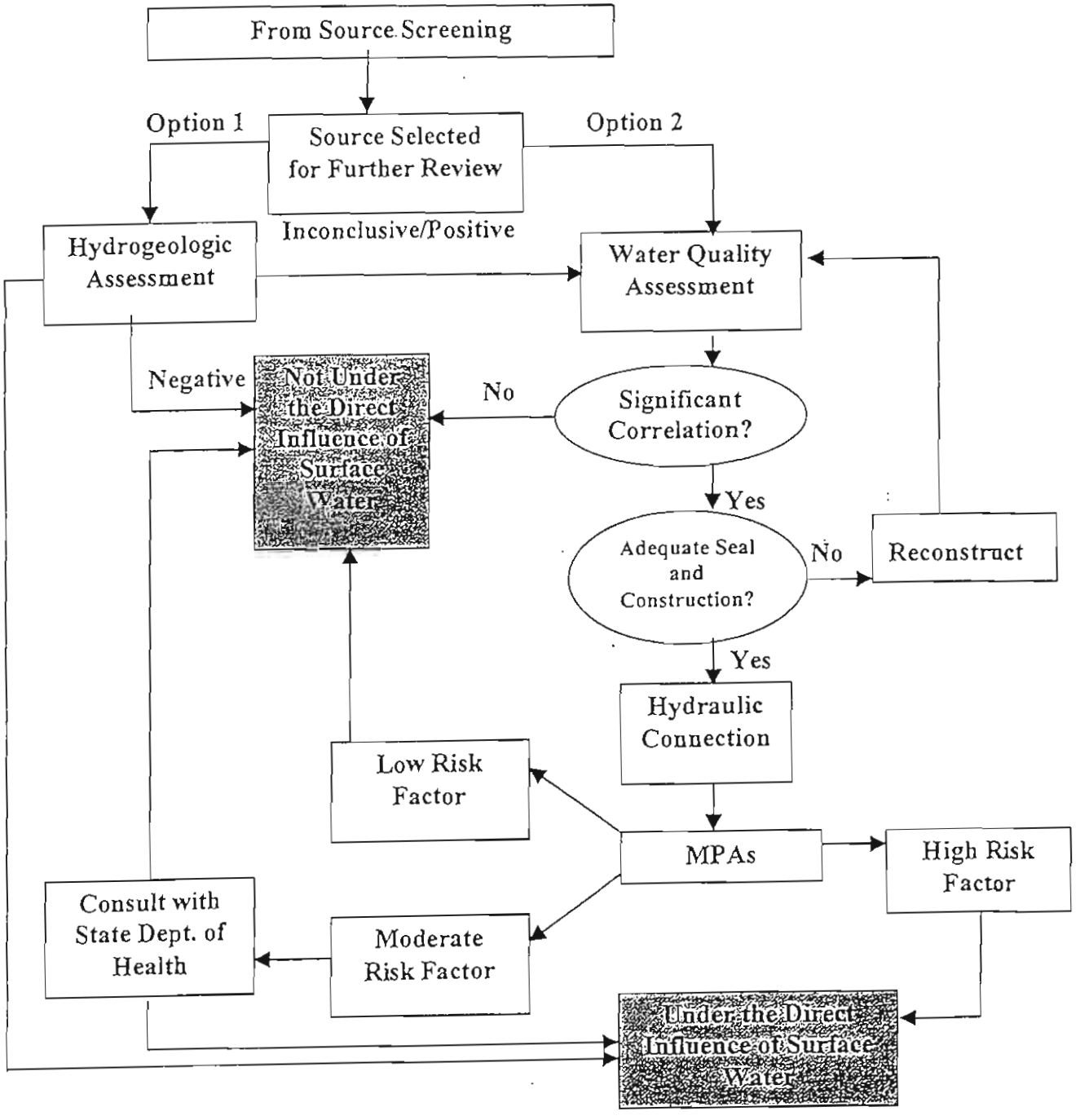


Figure 2: Detailed Evaluation Phase Methodology



Detailed Evaluation Phase

Once a ground water source has been selected for further review, as a result of the Source Screening Methodology, the procedure described below should be closely followed. The protocol's steps are presented in the flowchart in Figure 2. The water supplier is responsible for carrying out the studies required by the protocol. The water system has two evaluation options. The first option requires a detailed hydrogeologic assessment that addresses the potential of surface water to move quickly to the subsurface collection device. The second option entails an evaluation of water quality parameters daily over a 12-month period. However, at any time during an evaluation the water system's operator can halt an ongoing evaluation by accepting a GWUDI designation and making the appropriate modifications to bring the system into compliance with the SWTR.

Hydrogeologic Assessment

If the first option, the Hydrogeologic Assessment, is selected, and results of the assessment indicate that the aquifer supplying the source is not in hydraulic connection with surface water, no further analysis will be required. However, if the LHD determines that the Hydrogeologic Assessment does not contain enough information to establish whether there is a hydraulic connection between surface water and the source water collection device, the water supplier should collect additional hydrogeologic information or proceed with a water quality assessment.

The Hydrogeologic Assessment option will be more effective when much of the data already exists, and the water suppler has access to a hydrogeologist to perform the work. The Hydrogeologic Assessment option is preferred when evaluating a new source. Data that should be available include: complete and accurate well logs, pump test data, existing monitoring wells or piezometers, and the availability of other related local hydrogeologic studies. It is recommended that the water supplier have their hydrogeologist meet with LHD officials before beginning work. The Hydrogeologic Assessment should be designed to provide the following information:

<u>Well Construction Details</u>

Provide a well log and construction diagram

Does the well and installation methods meet current standards?

Aquifer Characteristics

Aquifer geometry and texture, including the unsaturated zone
Saturated thickness
Hydraulic Conductivity
Transmissivity

Ground Water Flow Characteristics, Pre-Pumping and Pumping

Water table/potentiometric surface elevations
Ground water flow directions
Ground water flow velocity
Zone of contribution/influence of the well

Degree of Hydraulic Connection between Surface Water Source and Aquifer

Geology underlying surface water body
Characterization of bottom sediments in surface water body
Determination of vertical hydraulic gradient in surface water body
Hydraulic relationship between the surface water body and the well
Calculations of travel times between the surface water body and the well

Seasonal Variations in Hydrogeologic Characteristics

What are the likely changes in flow patterns during seasonal fluctuations or periods of drought?

The Hydrogeologic Assessment should include, as a minimum, geologic logs and construction details for the pumping well and any observation wells or piezometers; aquifer pumping test(s); a survey of the elevations of water level monitoring measuring points; water level monitoring of ground water and surface sources; and preparation of detailed maps of water table/potentiometric surface and geologic cross-sections. It may be necessary to install observation/monitoring wells or piezometers if these do not already exist.

In addition to requiring an assessment of hydrogeologic factors, the Hydrogeologic Assessment should include a description and review of the collection device (i.e., type, age) and a summary of any current or historical sanitary conditions. Any information available from previous sanitary surveys or field investigations should be included in the assessment, as appropriate.

Attachment 1 gives an example of a sanitary and field survey report form that can be used for information gathering.

To be definitive, a Hydrogeologic Assessment needs to include an interpretation of the information collected with respect to the potential for a hydraulic connection between a surface water body and the aquifer. The LHD has the discretion to decide whether the Hydrogeologic Assessment is sufficiently complete to warrant the conclusions. If the Hydrogeologic Assessment indicates a potential hydraulic connection, the water system should be required to initiate a water quality assessment.

Water Quality Assessment

In the Water Quality Assessment portion of the Detailed Evaluation Phase, the collection of daily conductivity and temperature data will be an important step in evaluating the extent of hydraulic connection and communication and estimating time of travel between the surface water and the subsurface collection device. This water quality information will be collected to establish whether there is hydraulic communication between the ground water source and the nearby surface water body. Furthermore, these data will also help determine if the time of travel from the surface water body to the ground water source is short enough to allow for the transport of *Giardia lamblia* cysts or *Cryptosporidium* oocysts to the ground water source.

A water supplier may choose to proceed directly to this step in the determination process, rather than carry out a hydrogeological assessment. In addition, those ground water sources for which Hydrogeologic Assessments have been completed, and the sources have been determined to have the potential for hydraulic connection, should next be evaluated with a water quality assessment.

The rationale for performing a water quality assessment is, with some exceptions, ground water that is not under the direct influence of surface water generally exhibits only minor variations in physical and chemical parameters. Conversely, surface waters, undergo more substantial variations as a result of the season, or rainfall or snowmelt events. If the ground water is hydraulically connected to the surface water, changes in the ground water's physical and chemical qualities should reflect surface water characteristics. For example, even a single ground water temperature reading which is outside the range typical for ground water provides a strong indication that GWUDI conditions may exist.

The extent of hydraulic connection and time of travel from surface water to the underground collection device should be evaluated under the guidance of the LHD using one year of daily

temperature and conductivity data collected by the water supplier. GWUDI determinations will be made by the LHD based on the presence/absence of similar seasonal fluctuations between the surface and ground waters. Where location and other logistical factors make daily measurements difficult, weekly measurements will usually suffice to detect large peaks and lag times. However, since high surface water levels during storms and floods can enhance or create GWUDI conditions (particularly when preceded by a drought), special efforts should be taken to collect daily source water measurements around periods of heavy precipitation and snow melt. It is very important to stress that all sampling plans stress the safety of sampling personnel, and no samples should ever be taken under unsafe conditions.

Temperature and conductivity measurements should be made at the ground water source and in the nearby surface water body. The sampling location for sampling for a ground water source should only characterize one underground collector and should not be influenced by air temperatures. In addition to safety concerns, surface water sampling locations should be selected that adequately characterize the water where the influence is suspected of occurring. For example, using a bridge to collect data from middle of a stream upstream of a well would be adequate for most cases, but collecting data from the surface of a shallow bay of deep lake would not likely be very useful. Precipitation should also be recorded, preferably using a gauge set up at the ground water source location. The biggest concerns for temperature data are the measuring device's precision and accuracy, and that temperature readings adequately reflect groundwater conditions. These concerns are best addressed by using high quality equipment, running the water long enough for the temperature to stabilize, collecting data at individual wells or spring collectors to minimize the influence of air temperature or source water blending, and the proper placement of remote sensors. Knowing the depth of the ground water collection point to assure that the depth is below the neutral zone for temperature variations is also important. The neutral zone is the depth below which there is no significant seasonal variation in ground water temperature due to the influence of air temperature. The neutral zone concept is not a concern when comparing conductivity data.

Temperature fluctuations in spring water may not necessarily indicate a surface water influence. This is because springs are the result of ground water discharge at the land surface. Therefore, spring water is above the neutral zone, and its temperature can be influenced by air temperature and heat from the sun. If spring water is moving slowly out of rock (e.g., one to five gallons per minute or less per square foot of production area), the water temperature may be influenced by variations in ground surface temperatures. When a determination is being made for a spring with wide temperature fluctuations, the LHD should weigh more heavily the conductivity and hydrogeologic information collected. In addition, spring collectors are often not located near a

surface water. Regardless, rapid fluctuations in water quality can indicate a surface water influence associated with direct runoff and/or a construction flaw.

Conductivity, or specific conductance, is the measure of water's ability to carry an electric current. This ability depends on the presence of ions in the water and the water's temperature. Ground water is generally higher in conductivity than surface water, because ground water dissolves minerals from substrates through which it moves. Generally, the longer the contact time between ground water and its aquifer, the higher the conductivity. However, there are exceptions to this generalization (e.g., surface water bodies receiving large amounts of ground water recharge, surface water bodies contaminated with salts, clays, metals, or polar organics). Conductivity data are especially important in making determinations for springs (and other situations where large seasonal fluctuations in temperature are expected). Overall, conductivity tends to be a more sensitive parameter than temperature and more difficult to interpret.

Water quality assessment data should also be analyzed to estimate the time of travel from the surface water body to the ground water source. Time lags between peaks, inflection points, and other features of the surface water and ground water temperature and conductivity graphs should be measured to derive an estimate of average time of travel. It should be noted that the accuracy of this method is best for short times of travel. Also, all else being equal, cold water moves through the ground more slowly than warmer water.

Once water quality assessment data are collected and analyzed, a determination must be made whether there is a significant hydraulic connection between the surface water body and the ground water source. A significant hydraulic connection exists when water movement from the surface water body to the ground water source allows for the transport of *Giardia lamblia* cysts and *Cryptosporidium* oocysts. Dilution and time of travel estimates should be considered when determining the significance of the hydraulic connection. If the time of travel estimate for the source is less than 100 days, a significant hydraulic connection should be assumed and the supplier should proceed to the next step, MPA.

If a source appears to be in significant hydraulic connection based on water quality data, a detailed evaluation of well construction (or source development) should follow. It is possible that measured variability in source water quality could be the result of surface water intrusion due to a construction flaw, rather than a hydrogeologic connection. Rainfall data collected as part of the water quality assessment will be useful for this evaluation. If construction flaws are found, the supplier must decide whether to repair or reconstruct the well prior to restarting the GWUDI determination process.

Unfortunately, temperature and conductivity data may not be very useful in making GWUDI determinations for seasonally operated drinking water sources located near lakes and reservoirs that thermally stratify. This is because water in the lower strata of the surface water does not show wide seasonal temperature changes, particularly during the summer months. Conductivity data can be of limited value when there are small differences in conductivity level between surface and ground waters, such as near seepage lakes with no inflow tributaries. In these cases, monthly raw water coliform monitoring should be performed during the operating season. If *E. coli* is found, MPA should be performed during the next July or August after the positive sample date. It is important to note that temperature and conductivity data are still useful in these settings to detect the influence of direct runoff entering the subsurface collector due to damage and/or construction flaws.

Microscopic Particulate Analysis (MPA)

When the hydrogeological conditions and/or water quality assessment results suggest that the ground water source is probably under the direct influence of surface water, then MPA shall be conducted. Information collected as part of the characterization of hydraulic communication and time of travel will be very important in determining the correct timing of MPA sample collection. MPA samples shall be collected at least twice, and the dates of sampling should represent worst case conditions, when maximum potential recharge from the nearby surface water is taking place (usually during extremely wet or dry periods).

It is important that geologic conditions, hydraulic communication, and MPA results be used together to make the final determination whether a ground water source is under the direct influence of surface water. MPA alone is not a reliable approach to making GWUDI determination, because improperly timed samples can yield meaningless results, and there are numerous difficulties associated with MPA methodologies.

Basically, the use of MPA in a GWUDI determination involves the careful enumeration of microscopic organisms (and other particulates) in the raw drinking water. These data are then systematically evaluated to determine if the particles found are more indicative of surface or ground water. Some of the organisms which are considered to be characteristic of surface water include: *Giardia*, *Cryptosporidium*, algae, diatoms, and rotifers.

All MPA methodologies used in GWUDI determinations must be approved by the Health Department. Overall, MPA analyses are difficult to perform, and their results are highly

dependent on the skill of the microscopist performing the work. In addition, organisms are often difficult to identify due to damage suffered during the concentration process, thereby reducing accuracy. Consequently it is advisable that representative surface water grab samples also be collected, because they can help in making difficult identifications. It is for these reasons, along with the difficulty in identifying suitable sampling times, that MPA results should not be used alone to make GWUDI determinations.

One acceptable method for collecting, analyzing, and interpreting MPA data was developed by Vasconcelos and Harris (1992). In this methodology (usually referred to as the EPA Consensus Method), samples are collected by concentrating large volumes (typically 500-1000 gallons) of raw drinking water using a fiber filter. Tables are then used to assign a relative risk rating based on types and numbers of organisms present. It is important to note that these tables were developed using a relatively small number of ground water samples that were analyzed by a number of different laboratories.

An alternative MPA method employed by the New York State Department of Health's Wadsworth Laboratory does not involve the filtration of large volumes of drinking water. Instead, 10 Liters of raw drinking water are collected, and organisms and particles are then concentrated for enumeration using a combination of bench-top filtration and sedimentation. In addition, the viability of algal chloroplasts (viable chloroplasts are an indication of a short travel time) are verified using UV-fluorescence. The risk rating system used with this methodology is conceptually similar to that used in the EPA Consensus Method, but it has been modified to account for the improved enumeration accuracy.

As mentioned previously, it is very important that hydrogeologic information and the results of the water quality assessment be used in conjunction with MPA to make the GWUDI determinations. Most importantly, MPA samples should be collected when the water quality assessment and hydrogeologic data indicate the greatest probability that surface water is impacting the ground water source, as indicated by hydrogeological and water quality data. The difficulty associated with selecting an ideal sampling time requires that at least two MPA samples be collected at different times of the year. MPA samples should be collected on occasions when the time of travel is suspected of being the shortest, usually when surface water levels are elevated (i.e., spring runoff and following storm events) and when pumping rates are highest. Ideally samples should be collected to reflect both periods of high and low regional ground water levels.

Even with the difficulties and uncertainties associated with these analyses, the information gained by MPA can help in the GWUDI determination process. It is relatively safe to conclude from a "high" MPA rating that the ground water source is under the direct influence of surface water, particularly when considered along with corroborating information collected in the earlier phases of a GWUDI evaluation. However, it is more difficult to conclude from a "low" MPA rating that the ground water source is not under the direct influence of surface water, because surface water influences often only occur intermittently under particular hydrologic conditions (usually during very wet or dry periods). Samples given a "moderate" MPA rating should be evaluated on a case-by-case basis, with assistance from New York State Department of Health scientists and engineers.

REFERENCES

1. Technical Reference PWS 180 - Sanitary Surveys of Public Water Supplies
2. Technical Reference PWS 72 - Determining Vulnerability To Contamination By Volatile Organic Chemicals
3. Vasconcelos, J., and S. Harris. 1992. Consensus method for determining groundwater under the direct influence of surface water using microscopic particulate analysis. Port Orchard, WA: U.S. Environmental Protection Agency.

Attachment 1. Example of sanitary and field survey report form that could be used to collect information for the hydrogeological assessment

Well Location and Characteristics

Water System Name/Address/Fed ID# _____

_____

_____

Name of Site _____

Description of Device _____

Name and Description of Nearby Surface Source(s) _____

_____

_____

Describe Datum for Elevations _____

Is there a USGS gauging station nearby, or other flow records available?_____

_____

Static Water Level

as a Depth _____ Date _____

as an Elevation _____ Date _____

Pumping Water Level

as a Depth _____ Date _____

as an Elevation _____ Date _____

Characterize pumping practices or spring flow (rates, seasonality, etc.)

_____

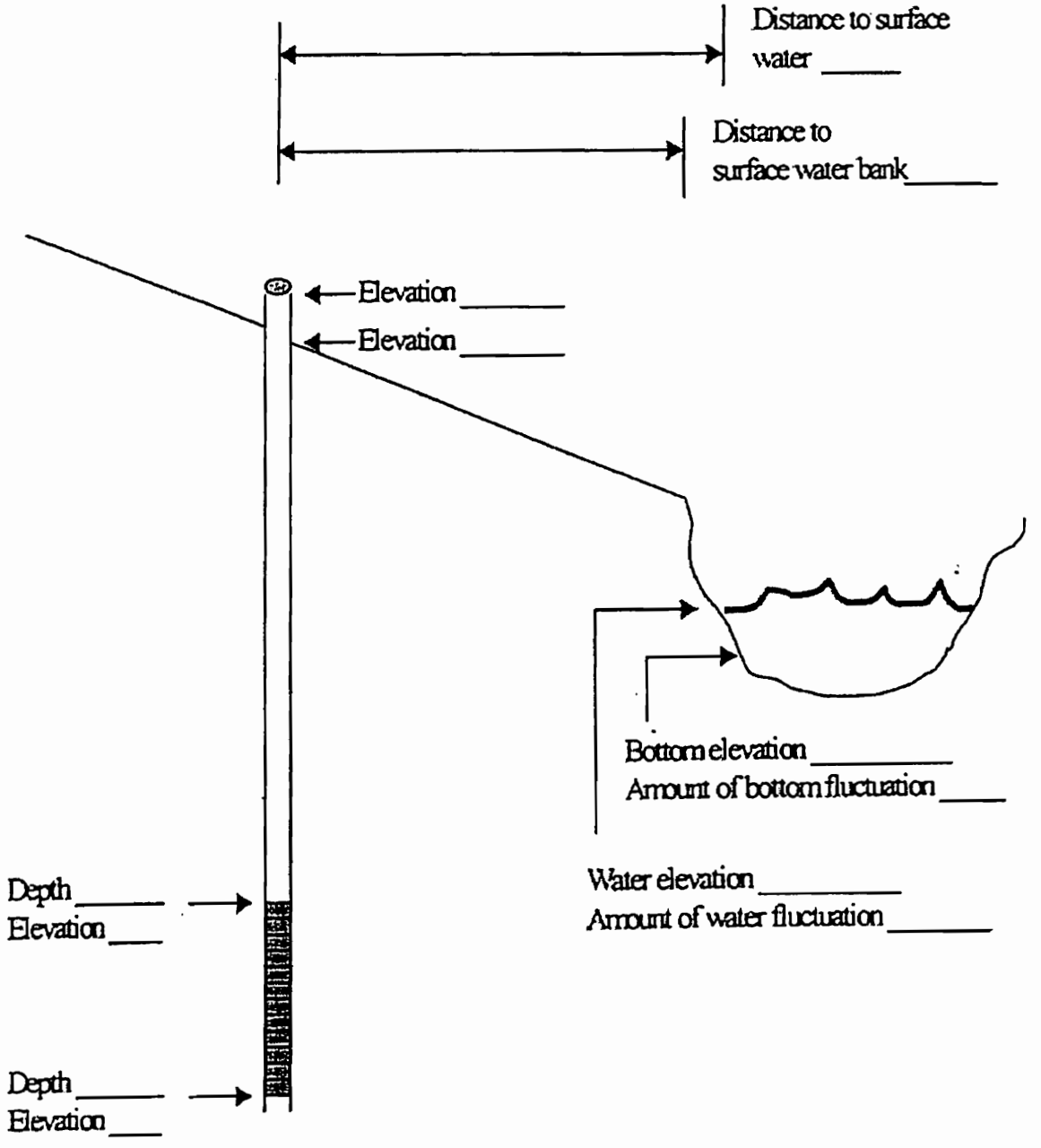
_____

Describe the vertical distance between the aquifer and the surface water under pumping conditions _____

_____

Describe the horizontal distance between the aquifer and the surface water source under pumping conditions _____

_____


Distance to surface water _____
Distance to surface water bank_____
Elevation _____
Elevation _____
Bottom elevation _____
Amount of bottom fluctuation _____
Water elevation _____
Amount of water fluctuation _____
Depth _____
Elevation ____
Depth _____
Elevation ____

Well Construction

Construction date _____

Does construction conform to the current standards (i.e., Ten State)? _____

Construction methods/materials _____

_____

Casing _____
Grouting _____
Screening _____
Well House _____
Other Information _____

Is a detailed plan/drawing available? _____

Hydrogeology

Is a geologic log for this well available? _____

What is the thickness of the unsaturated zone? _____

What are the hydraulic conductivities of the unsaturated zone and the aquifer? _____

Is there a confining layer? At what elevation(s)? _____

Describe _____

Does the surface water body penetrate the aquifer? _____

Draw the aquifer(s), confining unit(s), and water table using one or more cross-sections with at least one cross-sections parallel to the flow direction. _____

Summary of Sanitary Conditions

Describe the results of past sanitary surveys and give the location of written reports

_____

_____

_____

APPENDIX C

WATER CONSERVATION INFORMATION

Appendix
Sample Contents for Public Information on Water Conservation
(Information from AWWA and Pennsylvania Department of Environmental Protection)

Residential Water Conservation

Bathrooms

Facts:

- Toilets account for almost 30% of all indoor water use, more than any other fixture or appliance.
- Toilets installed prior to 1994, use as much as 3.5 – 7 gallons of water per flush and as much as 20 gallons per person per day.
- An average of 20% of all toilets leak.
- The third highest use of indoor water use is bathing.

Conservation Tips:

- Install low flow showerheads and low flow faucets. Consider installing low flow toilets.
- Turn the faucet off while brushing your teeth or shaving.
- Never use the toilet as a waste basket.
- Take short showers instead of baths.
- Check toilets periodically for leaks.

Kitchen and Laundry

Facts:

- Clothes washers can use as much as 30-35 gallons of water per cycle.
- Dishwashers can use as much as 25 gallons per cycle.
- A full dishwasher is more efficient than washing the same load of dishes by hand.
- Energy efficient appliances are usually water efficient too.

Conservation Tips:

- Only run dishwashers and washing machines when there is a full load.
- Consider replacing older appliances with newer, energy and water efficient appliances.
- Rinse vegetables in the sink in a pan of clean water, instead of letting the faucet run.
- Keep drinking water in the refrigerator instead of letting the faucet run and waiting until the water is cool.
- Use food wastes as compost instead of using a garbage diposal.

Outdoor Water Use

Facts:

- As much as 30% of water can be lost to evaporation by watering the lawn during midday.
- Landscaping accounts for 20-50% of all residential water use and provides the best opportunity for water conservation at home.

Conservation Tips:

- Sweep driveways, sidewalks and steps rather than hosing them off.
- Wash cars with water from a bucket.
- Avoid purchasing recreational water toys that require a constant stream of water.
- Use water-saving pool filters on swimming pools.
- Water lawns before 8 am and after 6 pm. Avoid watering on windy days. Water lawns only when necessary.
- Cover swimming pools to prevent evaporation.
- Check for leaks in outdoor faucets, hoses and pipes.

Municipal Water Conservation

- Implement a water-loss management program to repair leaks.
- Strive for universal metering of all customers.
- Install low flow faucets and toilets in municipal buildings.

Commercial, Business/Industrial Water Conservation

- Install low flow faucets, appliances and toilets.
- Detect and repair all leaks.
- Minimize the water used in cooling equipment. Shut off cooling units when not needed.
- Use high pressure, low volume nozzles on spray washers.
- Equip hoses with spring loaded shutoff nozzles.
- Consider water re-use practices.
- Handle waste materials in a dry mode where possible.
- Turn off all water flows during shutdowns.

Mandatory Water Use Restrictions

- No watering of lawns, gardens, landscaped areas, trees, shrubs and outdoor plants.
- No golf course watering.
- No washing of streets, sidewalks, driveways, garages, parking areas, tennis courts, or patios.
- No washing vehicles.
- No operating water fountains, reflecting pools, artificial waterfalls, etc.
- Do not serve water in restaurants, unless specifically requested.
- Do not fill or top off swimming pools.

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WATER CONSERVATION PROGRAM FORM

(Revised - June 1998)

TO BE COMPLETED AND SUBMITTED AS PART OF A NYSDEC WATER SUPPLY PERMIT APPLICATION
***SEE PAGE 6 FOR FURTHER INTRODUCTION AND INSTRUCTION REGARDING THIS FORM ***

If your water system already has its own written water conservation program, please feel free to submit it as a supplement to this WCPF. If your system is new, please indicate the water conservation measures that will be taken when the system is completed (e.g. All sources of supply and customers will be 100% metered)

I. GENERAL SYSTEM INFORMATION

Name of Applicant:		**DEC No.**
Street Address:		**WSA No.**
Post Office:	**County:**	**State & ZIP:**

Name & Title of Contact:	
Street Address:	
Post Office:	**State & ZIP:**
Applicant's Telephone:	**Contact's Telephone:**

II. SOURCES OF WATER SUPPLY

Please give amounts in gallons per minute (**gpm**), per day (**gpd**) or million gallons per day (**mgd**).

Source Type: **S** = Surface supply, **G** = Ground supply, **P** = Purchased supply
Source Status: **R** = Regular use, **S** = Standby use, **E** = Emergency use

Name of Source	Source Type	Source Status	Tested Capacity	Actual Current Withdrawal	Start-up Year

Name of Applicant:	WSA No.

III. WATER USAGE AND METERING

The water production data requested in this section should be available from the monthly "Water System Operation Reports" required by the State or Local Department of Health.

For unmetered systems, please provide your best estimates for water production and/or consumption.

Are all sources of supply (including major interconnections) equipped with master meters?	
What percentage of your system is metered? %	How often are they read?
Number of service connections?	Total population served?
How many meters are recalibrated and/or replaced each year?	

Water Production for calendar year _____		**Water Consumption for calendar year _____**	
Total metered water production :		Total metered water consumption:	
Average day production (total/365):		Average day consumption (total/365):	
Peak day production (largest single day):		Per capita usage per day (avg. day/pop. served):	(gpcd)

What are your future goals and schedule for water system metering?_____

_____

_____.

Recommendations:

* 100% metering of all water system connections, including public buildings.

* Master meters should be tested and calibrated annually.

* Customer meters should be recalibrated or replaced at least once every 15 years or in accordance with an optimum meter replacement schedule developed using the American Water Works Association (AWWA) Manual M6.

* Quarterly meter reading and prompt billing with rates that reflect amount of water used.

Name of Applicant:	WSA No.

IV. WATER SUPPLY AUDIT

Do you conduct a system water audit at least once each year? _____.
If yes, please submit a copy of your latest audit in addition to completing the following section.

** Water Supply Audit for Calendar Year _____

Total metered water production (from previous section)		Total		% of Total
Total metered water consumed (from previous section)		subtract		
Authorized unmetered usage		subtract		
e.g. Unmetered public bldgs. Firefighting & training Main flushing Street cleaning		subtract		
		subtract		
		subtract		
Water lost to leaks that have since been repaired		subtract		
TOTAL UNACCOUNTED-FOR WATER		Sub-total		
Unaccounted-for water breakdown	Meter under-registration	subtract		
	Unrepaired leakage	subtract		
	Other:	subtract		
** Water measurement and accounting techniques are available in NYSDEC's January 1989, (re-printed February 1998) Water Conservation Manual.			0	

What are your future goals for water system auditing?_____
_____
_____.

Recommendations:

* At least once each year, a system water audit should be conducted using metered water production and consumption data to determine unaccounted-for water.

* Quantify all authorized water uses by consumption categories (e.g. residential, industrial, municipal etc.).

* Keep accurate estimates of authorized unmetered water use (e.g. firefighting, main flushing, etc.).

Name of Applicant:	WSA No.

V. LEAK DETECTION AND REPAIR

Do you regularly survey your system for leaks with listening equipment?

Total miles of distribution pipe	Percent of system surveyed each year	Miles of pipe surveyed each year	Listening equipment used	Year of last survey	Number of leaks found	Number of leaks repaired

Do you have a regular water system rehabilitation program? _____.
If yes, give details: _____

What are your future goals for water system leak detection and repair?_____
_____
_____.

Recommendations:

* Check at least one third of your water distribution system for leaks each year.

* Fix every detectable leak as soon as possible.

* Have an on-going system rehabilitation program.

Name of Applicant:	WSA No.

VI. WATER USE REDUCTION

Have you distributed information to residential customers on household water saving devices and ways to reduce water use? _____.

Have you distributed water conservation information to industrial and commercial customers that promotes recycling and reuse? _____.

Do you have a program to retrofit public buildings with water savings fixtures and encourage the private sector to do the same? _____.

Do you have lawn sprinkling time restrictions during the summer or periods of peak demand?____.
If yes, please describe: _____
_____
_____.

Do you have a plan that takes progressive steps to further reduce outdoor water use during drought conditions with a procedure to assure compliance? _____. If yes, please describe:
_____
_____

What are your future goals for reducing water usage? _____
_____
_____.
_____

Recommendations:

* Carry out a public information program that promotes water conservation practices by allcategories of water users (e.g. residential, commercial, industrial, etc.).

* Retrofit public buildings with water saving fixtures and encourage the private sector to do the same.

* Use lawn sprinkling time restrictions (e.g. Odd/even days, morning and evening hours) during the summer and outdoor water use bans during times of drought.

* Adopt a procedure to be followed in times of drought that calls for a progression of restrictions on water use specifying: who will reduce, how, and by how much, along with actions to be taken to assure compliance.

Name of Applicant:	WSA No.

VII. CERTIFICATION OF WATER CONSERVATION PROGRAM:

To be signed by the owner or official of the municipality or corporation operating this water system.

I hereby affirm that the information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

Date:_____ Signature:_____ Title:_____

DISCUSSION:

Effective January 1, 1989, New York State Environmental Conservation Law (ECL 15-1501) has required that all new applications for a NYSDEC Public Water Supply Permit include a water conservation program. This Water Conservation Program Form (WCPF) is intended to be a guide in completing this requirement.

The WCPF has been set up to cover the following basic elements of a water conservation program: Source Water Inventory, Water Usage and Metering, Water Supply Auditing, Leak Detection/Repair and Water Use Reduction. The recommended actions listed at the bottom of each page represent DEC water conservation policy objectives and should be factored into your program development. Additional water conservation measures such as increasing block water rate structuring, non-residential water use reduction or water efficient landscaping may also play an important role in your system's program and should certainly be considered when applicable.

Water supply permit applicants can consult the NYSDEC publication entitled, "Water Conservation Manual For Development of a Water Conservation Plan", January, 1989 (Re-printed February 1998) for details regarding the development of these water conservation practices. Copies of this manual can be obtained through your DEC Regional Offices.

The American Water Works Association (AWWA) is also an excellent source of information regarding water conservation and public water supply systems in general. Information ranging from technical manuals to public education bill stuffers are available from AWWA at reasonable cost by calling 1-800-926-7337.

As a final note, the old "Bureau of Water Resources" has been incorporated into the "Bureau of Water Permits" and can now be contacted at (518) 457-1157.