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# Lake Water Cooling Project
## Webster, New York

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## Abstract

O'Brien & Gere Engineers in conjunction with the New York State Energy Research and Development Authority, Monroe County Water Authority (MCWA) and Xerox Corporation are jointly evaluating a new water supply system which will develop a new source of potable water, and a cold water air-conditioning and cooling system.

The proposed project has a vast array of benefits, from the local to global level. The environment, economy, energy resources and water supply will benefit greatly if this project is constructed.

Lake Ontario has virtually an unlimited and sustainable source of naturally chilled water with the potential to replace conventional energy-dependent chlorofluorocarbon (CFC) refrigerant-based mechanical equipment used by industry. Conventional chiller systems are typically used to cool equipment and provide facility air-conditioning. Access to this energy efficient lake water alternative through the creation of a "cold water district" will provide an economic advantage for existing industry and future development and growth into the 21st Century.

## 1. Introduction

### 1.1 General

The New York State Energy Research and Development Authority (NYSERDA), Xerox Corporation (Xerox), and the Monroe County Water Authority (MCWA) are jointly investigating the feasibility of establishing a cold-water district in the Town of Webster, New York. The district would be created to facilitate use of naturally chilled water withdrawn from Lake Ontario to meet comfort and process cooling requirements for Xerox and other existing and prospective businesses.

The proposed project has a vast array of benefits ranging from the local to the global level. The environment, economy, energy supply, and water supply will benefit greatly if this project is implemented.

Historically, access to a reliable water supply has enhanced economic development and the growth of host communities. Lake Ontario is an established, reliable, and plentiful water source providing economic, recreational, and environmental benefits to regional water purveyors, industry, and municipalities in both Canada and the United States.

Lake Ontario has the potential to add even more value: a virtually unlimited and sustainable source of naturally chilled water to replace conventional industrial energy-dependent chlorofluorocarbon (CFC) refrigerant-based mechanical equipment. Conventional chiller systems are used to cool equipment and provide facility air-conditioning during summer months. Facilitating access to an energy-efficient lake water alternative through the creation of a "cold-water district" will provide an incentive for communities that want to retain and attract businesses.

Xerox has been investigating the feasibility of replacing mechanical chiller equipment with naturally chilled water from Lake Ontario to meet comfort and process cooling loads at its Joseph C. Wilson Technology Center in Webster, Monroe County. This is being evaluated in conjunction with development of a new raw lake water intake by MCWA to increase the reliability and capacity of the regional water supply system. The combined project, referred to as the Lake Water Cooling Project (Figure 1), represents a model for progressive planning.

This package summarizes the project and its benefits, as well as the existing partnership between MCWA and Xerox. Conceptual information herein is based on previous investigations conducted by MCWA and Xerox. Information relating to Xerox's participation as the core customer of the proposed cold-water district will serve as a model upon which to base future growth within the district. Qualitative benefits derived by Xerox, as described herein, may be typical of what future customers can anticipate.

## Monroe County Water Authority

MCWA is a water purveyor established in 1951 as a public benefit corporation created by, and existing under, Title 5 of Article 5 of the New York State Public Authorities Law. Currently, MCWA has the capacity to treat and distribute approximately 145 million gallons (mg) of potable water per day from the Shoremont Water Treatment Plant (WTP) (140 mgd) in the Town of Greece and Brockport WTP (5 mgd) in the Town of Hamlin, both in the western part of Monroe County.

The Water Resources Management Strategy Act of 1984 (amended), Chapter 15 of the New York State Environmental Conservation Law (ECL) directed the New York State Department of Environmental Conservation (NYSDEC), with participation from the New York State Department of Health (NYSDOH), to "develop a statewide strategy to provide a basis for better state and local water supply management." As the third largest water purveyor in New York State, MCWA's role as the major water supplier to the region is consistent with the Genesee sub-state strategy (Monroe, Livingston, Wayne, and Ontario counties) of the Statewide plan published in 1985 by NYSDEC.

Consistent with State strategy, MCWA is responsible for providing, in a cost-effective manner, a high-quality water supply to its customers. Construction of an east-side water-supply system has been considered since MCWA's inception. Over the years, potential configurations and implementation schedules have been adjusted in response to available alternatives, water supply purchases, and other viable options. These modifications have been made to adapt to changing regulatory mandates, supply agreements, and the location and rate of growth of water demands in the service area. The overall goals and benefits associated with developing an additional water-supply system have remained the same.

MCWA's objectives include:

- *Improved Water-Supply Reliability.* MCWA's current production sources are both located in the western portion of the service area. It also has limited ability to obtain water from the City of Rochester's upland supply. Development of this project will provide an additional production source in the eastern portion of the service area that will significantly improve reliability of the production, transmission, and storage system.

- *Improved Water-Supply Capacity.* Water-supply demands continue to increase in MCWA's service area. In addition, MCWA continues to grow as a regional water supplier outside its existing service area (e.g., Wayne County). The proposed facilities will allow MCWA to meet both current and projected potable water demands of the area.

- *Reduced Water-System Pumpage.* To convey water from its west-side WTP under peak demands, MCWA must pump the water three additional times. Up to one megawatt of electric power will be conserved annually if the water is produced on the east side of MCWA's service area, closer to its point of consumption.

## Xerox Corporation

Xerox is an international, Fortune 500 corporation that operates a manufacturing and technology center in the Town of Webster. Xerox's Joseph C. Wilson Center for Technology employs approximately 7,500 people. Primary activities at the site include research, development, and manufacturing of business equipment and associated consumables (e.g., toner).

As a result of the Montreal Protocols[1] and the 1990 Clean Air Act Amendments, which banned the manufacture of chlorofluorocarbon (CFC) refrigerants after 1996, users of CFC-based refrigerants, including Xerox have been evaluating cooling-system alternatives to meet plant process and comfort cooling loads. Current CFC-based cooling equipment used by Xerox consists of electronically driven mechanical chillers in decentralized locations around its Webster complex.

Xerox's project objectives include:

- Development of a cold-water cooling and air-conditioning system at the Joseph C. Wilson Center for Technology, a natural, energy-efficient, economical, and environmentally sound alternative to existing conventional electrically driven mechanical chiller equipment.

## 1.2 Environmental benefits

Benefits of the project will go beyond Xerox's boundaries, the cold-water district, and MCWA's service area. The environmental implications are at the least regional, if not global. These environmental benefits include:

- Using a renewable resource (cold water) as a natural cooling alternative. Preliminary evaluations indicate that sufficient quantities of cold water exist at depths of 250 feet and greater to supply Xerox and potential future users with consistent, year-round quantities of chilled water. Horizontal and vertical circulation patterns in the lake act as a system to replenish this natural resource.

- Protecting the atmospheric ozone layer by eliminating the use of CFC refrigerants and their replacement chemicals by cold-water district customers. The cold-water district will be designed to provide more than 20,000 tons (270 million Btu) of cooling capacity, forgoing the need to operate mechanical chillers that utilize CFC-based and other refrigerants. Operation of the cold-water district is projected to reduce the total use of refrigerants by up to 60,000 pounds per year.

  The cold-water district's capacity can be readily increased by upsizing lake water supply pumps and installing additional heat exchangers at the central heat-exchanger building. Future expansion of the cold-water district will further reduce the need for mechanical chillers.

- Reducing air emissions (e.g., carbon dioxide, nitrogen oxides, and particulate matter) due to reduced reliance on fossil-fuel-derived electric energy. Artificially created chilled water requires electricity to power mechanical chiller units. Under normal operating conditions, electric-powered mechanical equipment emits odors, emissions, and particulates. Eliminating the need for this equipment also eliminates associated emissions.

- Cutting chemical use (e.g., corrosion inhibitors) because of a reduced need for cooling towers. In addition to eliminating CFCs, the cold-water district would significantly reduce reliance on water

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[1] The Montreal Protocols were adopted in 1987 as an agreement to institute control measures to eliminate production and consumption of ozone-depleting chemicals by 1996, with a 10-year grace period for developing countries.

treatment chemicals at Xerox's Webster complex, as well as future sites in the district. Mechanical chilling equipment uses cooling towers to transfer latent heat from the system to the atmosphere. Treatment chemicals are used to prevent corrosion in the open system. The chilled-water system is a closed system with no need to discharge lost heat to the atmosphere. Latent heat is returned to the lake water supply at the heat-exchanger building and conveyed back initially to Lake Ontario through an outfall diffuser, and ultimately (as water supply demands increase) to the WTP for treatment. Reliance on cooling towers and treatment chemicals is significantly reduced.

- Decreasing wastewater discharges to the municipal sanitary sewer system. In the existing system, blowdown of cooling-tower water is discharged to the municipal wastewater treatment system. Minimizing the use of cooling towers reduces reliance on the municipal system and subsequently increases the capacity (or ability) of the municipal system to treat future demands.

## 1.3 Energy savings

Project-related energy savings would be realized due to:

- Reduced water system pumpage. Construction of a new WTP in the eastern portion of MCWA's service area would eliminate current electrical demands associated with pumping water from MCWA's existing Shoremont WTP west of the Genesee River. To convey water from its existing Shoremont WTP under peak demands, MCWA must pump the water three additional times. Up to one megawatt of electrical power (equivalent to the daily energy needs for 1,000 homes) will be conserved annually if the water is produced in the eastern part of the county, closer to its point of consumption.

- Reduced electrical demand within the cold-water district. Replacement of electrically driven mechanical chiller equipment with naturally cooled water will significantly reduce electrical power demands the cold-water district. Initial estimates indicate that a net decrease in electrical demand of between 10 to 12 megawatts per year (i.e., equivalent to the energy needs for 10,000-12,000 homes) may be achieved. Energy savings will increase as additional customers are added to the district.

## 1.4 Economic development

Transmission and distribution of chilled water to cold-water district customers would be a natural extension of MCWA's responsibilities as a regional water purveyor. As shown in Figure 1, the customer base would be centralized around an industrial-zoned portion of the Town of Webster. Formation of a special use or cold-water district would enable the Town, County, and State to promote economic development based on access to chilled water. In essence, the District would:

- Provide an additional marketing tool for attracting new business opportunities.
- Promote sustainable development and environmental protection for the local, regional, and global community.
- Establish a mechanism by which the chilled-water system would be maintained.
- Generate short-term (construction-related) and long-term employment opportunities in the area.

To enhance economic development opportunities, the Town of Webster adopted a growth management plan that establishes policies designed to attract new industries. According to the plan, new growth is preferred on undeveloped industrial-zoned parcels. Such parcels, including Xerox land holdings in the Town of Webster project area, are included in this plan. In addition, the Monroe County Department of Economic Development, in conjunction with the Town of Webster's Economic Development Committee, sponsored a study that outlined primary development objectives, including new job opportunities and expansion of the tax base.

The water-supply portion of the project supports these efforts by:

- Improving water-supply reliability and capacity to meXwater-supply reliability and capacity to meet the needs of MCW
- Facilitating additional sales of water in the region as necessary.

The formation of a cold-water district and access to a reliable, high-quality potable water supply would enhance economic development opportunities in this area. MCWA will coordinate these efforts with State, County, and Town government.

## 1.5 Project costs

This section presents the estimated capital costs for the Chilled Water Distribution System, Centralized Heat Exchanger Facility, and Lake Water Supply components of the Lake Water Cooling Project The summarized revised costs are presented in Table 1-1 and include:

**Table 1-1.** *Lake Water Cooling Project Capital Cost Breakdown.*

| Component | |
|---|---|
| Lake Water Supply Component | $62,240,000 |
| Centralized Heat Exchanger Facility | $20,760,000 |
| Customer-Owned Chilled Water Distribution System | $18,240,000 |
| Water Treatment Plant | $25,620,000 |
| Land Acquisition (extracted from Lake Water Supply Component) | $1,600,000 |
| Total Costs | $128,500,000 |

## 1.6 Project schedule

The preliminary project schedule indicates the duration of the Lake Water Cooling Project is approximately 3 years. The project schedule is streamlined to begin operating in the Spring of the first year of operation. In order for the project to maintain a 3 year duration, major schedule items need to be considered. These include the following:

- Project financing must be received prior to the final design phase and construction phase;
- The Environmental Review Phase and the Preliminary Engineering Phase must be conducted at the same time. If the Environmental Phase occurs before the Preliminary Engineering Phase, then the SEQRA approval will be a critical path issue before construction can begin. This will constrict the preliminary and final design, or it will lengthen the project by as much as 10 months;
- Permitting must be completed before the Bidding Phase begins;
- The Final Design Phase components must be staggered with the Bidding Phase components to ensure that the priority project items are completed first.
- Construction and installation of the plastic pipelines must occur in agreeable weather (eg., summer of fall). The preliminary schedule currently indicates a time frame from July to December in which the plastic pipeline can be installed.
- Preliminary subsurface investigation must occur in the summer months as shown on the preliminary schedule.

## 2. Basis of design

In 1992, Xerox and MCWA signed an agreement to combine planning efforts to serve their mutual and individual objectives, as well as community interests. The Lake Water Cooling Project is a public/private partnership aimed at consolidating, sharing, and conserving natural and financial resources; strengthening community assets; and protecting the local and global environment. Economies of scale will be achieved as a result of shared MCWA and district cooling components.

Components of these systems will be designed to convey "cold" (approximately 40-42°F) water from Lake Ontario to meet the combined demands of MCWA's new WTP and cold-water customers, including Xerox, within a proposed cold-water district. Conceptual descriptions of the project system and its components are provided below. The conceptual design information is intended to provide a fundamental understanding of the project components and their interrelationships. A process flow schematic is provided in Figure 2.

This Section presents the basis of design criteria which has been proposed for the Lake Water Cooling Project.

The basis of design criteria is summarized in the following subsections:

- Cold Water District Facilities
- Lake Water Supply System

Each subsection includes a discussion of major basis of design considerations, design requirements associated with each of the major project components, and other relevant operational or environmental factors.

### 2.1 Cold water district facilities

The Cold Water District facilities include the components of the project necessary to generate and distribute chilled water to customers. Collectively, these facilities are referred to as the Cold Water District. Ownership and operations and maintenance responsibilities of the Cold Water District have not yet been firmly established. The term "District" is used in this report for illustrative purposes only. It should not be construed to have any legal consequences relative to ownership or management structure.

The Cold Water District facilities include a Heat Exchanger Building and Chilled Water Distribution piping up to, and including, each customer's meter. Chilled water system components located downstream of the meter will be the financial, design, and operational responsibility of the customer.

The following sections describe the revised basis of design for the Cold Water District facilities. The Cold Water District sections include estimated cooling loads, basis of design considerations, and design requirements.

#### 2.1.1 Estimated cooling loads

The lake water temperature and flow rate are the major factors which dictate the effective cooling capacity of the Lake Water Cooling Project. Other factors include the specific heat exchanger performance capabilities and the required chilled water temperature at the point of service. At a design lake water temperature of 42°F, it is estimated that approximately 3.4 gpm of lake water will be required to develop 1 ton ( 12,000 btu/hr) of effective cooling capacity.

*Design Cooling Loads*: Based on "economies of scale" related to the construction of a new lake water intake system and the cooling load requirements provided by the currently identified anchor customer, an initial lake water supply capacity of 100 mgd (69,444 gpm) has been selected for this project. It is estimated that the initial construction of the lake water cooling project will be capable of producing up to 20,400 tons of cooling capacity. Design cooling loads are summarized in Table 2-1.

**Table 2-1** *Design Cold Water District Cooling Loads (Initial Construction)*

| | Cooling Load |
|---|---|
| Design Capacity | 20,400 Tons |
| Anchor Customer Cooling Requirements (1) | 18,000 Tons |
| Currently unidentified additional customers | 2,400 Tons |

Notes:
1. Based on comfort/process cooling load requirements provided by Xerox.

Based on the information presented in Table 2-1, the Cold Water District will have additional capacity to meet cooling loads in excess of those required by the anchor customer. A preliminary estimate of potential current and future customers within the Town of Webster has been developed based on current zoning and land use planning criteria within the District. The available property owner data were provided by MCWA and estimate the potential current and future customers and their building square footages. Using a design lake water temperature of 42°F and a vendor supplied heat exchanger performance rating of 3.4 gpm to obtain 1 ton of effective cooling capacity, 100 mgd will provide enough comfort cooling capacity for over 1 million square feet of existing or future office spaced developed within the District in addition to fulfilling the cooling requirements of the anchor customer.

*Potential future cooling loads*: The lakewater facilities could be potentially expanded to 150 mgd. which corresponds to a cooling capacity of 30,600 tons based on equivalent heat exchanger information. To increase the flow from 100 to 150 mgd will require additional components and money, such as a potential third intake pipe from the intake crib to the transition structure, additional pumps in the Lake Water Pumping Station necessary to handle the flow increase, and a potential additional intake crib.

The potential future cooling load capacity of the Cold Water District (at a lake water flow rate of 150 mgd) is summarized in Table 2-2.

**Table 2-2.** *Future Cold Water District Cooling Loads (Future Expansion)*

| | Cooling Load |
|---|---|
| Future Maximum Capacity | 30,600 Tons |
| Initial Cold Water District Capacity (1) | 20,400 Tons |
| Potential additional future customers (2) | 10,200 Tons |

Notes:
1. Based on design cooling load capacity presented in Table 2-1.
2. Requires future modifications to increase lake water flow rate to 150 mgd.

*Cooling Load Profile*: In order to calculate conceptual-level operating and maintenance costs for the Cold Water District Facilities, it is necessary to understand what cooling loads are being served, and how they vary throughout the year. At this point in the project the exact nature of these loads is unknown, so a "typical" customer cooling load profile was developed, and it is assumed that this load profile applies to all customers.

For purposes of developing a cooling load profile, it has been assumed that the bulk of the "typical" cooling load is comfort cooling and that comfort cooling is directly dependent on outdoor air temperature. Specifically, when outdoor air temperature is above 55°F, comfort cooling systems will be energized, and the amount of cooling required is directly proportional to air temperature. Therefore, a comfort cooling load can be calculated for each discreet temperature between 55°F and 95°F.

Although the bulk of a "typical" cooling load is comfort cooling, a small portion will be "process" cooling. For purposes of this conceptual evaluation, it has been assumed that the process load is a constant 1000 tons, year-round. Therefore the peak comfort cooling load will be 19,400 tons, and the peak process cooling load will be 1000 tons, for a total of 20,400 tons as described above.

### 2.1.2 Basis of design considerations

Basis of design considerations relating to the Cold Water District facilities are shown in Table 2-3. A schematic representation of the basis of design information for the Cold Water District facilities is presented in Figure 2.

**Table 2-3.** *Chilled water system basis of design.*

| | |
|---|---|
| Design cooling system capacity at customer(s) | 20,400 tons |
| Required lake water flowrate | 100 mgd |
| Raw lake water inlet temperature | 39°F to 42°F |
| Temperature rise between raw lake water inlet and heat exchangers | 1°F |
| Raw lake water at inlet to heat exchangers | 43°F |
| Raw lake water temperature rise across heat exchangers | 8.5°F |
| Pressure drop across heat exchangers | 20 psi |
| Raw lake water temperature at outlet of heat exchangers | 51.5°F |
| Chilled water flow rate | 71 mgd |
| Chilled water supply temperature leaving heat exchangers | 44°F |
| Temperature rise between heat exchangers and point of service (supply) | 1°F |
| Chilled water temperature at point of service | 45°F |
| Temperature rise at point of service | 10°F |
| Temperature rise between point of service and heat exchangers (return) | 1°F |
| Chilled water return temperature at heat exchangers | 56°F |

### 2.1.3 Design requirements

*Central heat exchanger facility.* The Central Heat Exchanger Facility will be located south of the future Water Treatment Plant on Basket Road, as shown on Figure 1. The Heat Exchanger Facility will house the individual heat exchangers, chilled water delivery pumps, and ancillary equipment required to generate and deliver chilled water to Cold Water District customers.

It is anticipated that the initial Heat Exchanger Facility will be approximately 130 feet long, 85 feet wide, and 25 feet high; providing a floor area of approximately 11,050 square feet. A pre-engineered steel frame structure with insulated metal panels is proposed. The building will be designed for future expansion to house the equipment required to meet potential future cooling loads.

The conceptual design of the Heat Exchanger Facility is based on a peak raw lake water flow rate of 69,444 gpm (100 mgd) and a peak chilled water flow rate of 49,240 gpm (71 mgd). The building incorporates 13 heat exchangers of the plate-and-frame type, consisting of steel frames and stainless steel plates. Plate-and-frame heat exchangers were selected for this application because they can attain the desired 1°F temperature approach, have a lower capital cost, a smaller size and footprint, a lower pressure drop, and are easier to maintain than other heat exchanger types.

The raw lake water flow rate through the Heat Exchanger Facility will be controlled using an in-line flow meter and flow control valve installed downstream of the heat exchangers. Prior to entering the heat exchangers, the raw lake water flow stream will pass through strainers to remove fine particles that might otherwise clog downstream equipment. Collected material will be disposed of at an approved landfill site.

Chilled water will be routed through the heat exchangers, where it will be cooled to 45°F by the colder lake water. It will then be pumped to the customers through the Chilled Water Distribution Supply piping. At the customer, it will be used for cooling, absorbing the heat rejected by the customer's process or comfort cooling loads. It will then return to the Heat Exchanger Facility, where the customer's heat will be rejected to lake water in the heat exchangers, and the chilled water will again be cooled to 45°F.

*Chilled water distribution system*: The Chilled Water Distribution piping will be routed from the Heat Exchanger Facility directly south and then west to Salt Road. The piping will then branch north and south, extending approximately 500 feet in each direction along the east side of Salt Road. The proposed routing is shown in Figure 1.

Six chilled water pumps, five on-line and one backup unit, each rated at 350 horsepower will be provided to meet the range of anticipated cooling load requirements. Each pump will be capable of providing approximately 9,850 gpm at 115 ft total dynamic head. Chilled water pumping rate will be varied by means of variable-speed drives, based on the pressure in the chilled water supply header. This approach will minimize power consumption.

Each customer will be provided with a metering device at their property line. This device will be installed in an underground vault. The Cold Water District will furnish, operate, and maintain Chilled Water Distribution piping through the meter and vault. The customer will furnish, operate, and maintain piping on their side of the vault.

## 2.2 Lake water supply system

The Lake Water Supply System consists of the lake water intake, lake water pumping station, lake water supply pipeline, lake water return pipeline, and return outfall. An overall supply system profile is presented as Figure 3. The system is designed to withdraw water from Lake Ontario at a sufficient depth to provide consistently "cold" water suitable for use by the Cold Water District and as a raw water supply source for the Monroe County Water Authority's new water treatment facility.

Water withdrawn from the lake will be pumped to the Heat Exchanger Facility. After passing through the lake water side of the Heat Exchanger Facility (to exchange heat with the Chilled Water Distribution System), the water will be used as a raw water source for the Monroe County Water Authority's public water supply system or returned to Lake Ontario via a return pipeline and outfall.

### 2.2.1 Basis of design considerations

The basis of design of the Lake Water Supply System is dependent on the following major considerations:

- lake water temperature required to satisfy cooling loads within the Cold Water District
- flow rate required to satisfy cooling loads within the Cold Water District and potable water supply requirements of the Monroe County Water Authority

A summary of each of these basis of design considerations is presented below.

*Lake water temperature:* The relationship of depth and water temperature within Lake Ontario varies seasonally. As part of the previously conducted engineering and environmental studies, a statistical model was developed to assess the reliable availability of cold water at the proposed intake location under varying seasonal conditions. The model was developed based on historic lake water temperature data obtained from the following sources:

- 20 year history from ships - Canadian National Research Institute (NWRI)

- Freecool (Toronto) thermistor data - May 1980 to October 1980
- Canadian Centre for Inland Waters (CCIW) data - 1984 to 1991
- O'Brien & Gere lake water temperature study developed for the Xerox corporation in 1991
- Temperature monitoring station installed by Xerox Corporation in proximity to the proposed intake site - October 1992 to August 1993

**Table 2-4.** *Statistical analysis - lake water temperature.*

| | Water Depth Range | | | |
|---|---|---|---|---|
| **Parameter** | **100 ft - 150 ft** | **150 ft - 200 ft** | **200 ft - 250 ft** | **250 ft -300 ft** |
| # data points | 438 | 267 | 126 | 36 |
| Mean | 43.7°F | 40.3°F | 39.3°F | 38.9°F |
| Std Deviation | 6.1°F | 3.6°F | 1.7°F | 1.1°F |
| Variance | 37.5°F | 13.2°F | 2.8°F | 1.1°F |
| Confidence interval | | | | |
| 99.0% | 66.3°F | 55.9°F | 46.0°F | 41.3°F |
| 95.0% | 57.6°F | 47.0°F | 42.6°F | 41.3°F |
| 90.0% | 51.7°F | 44.3°F | 41.3°F | 40.8°F |

As part of the previous engineering and environmental evaluations of the Lake Water Cooling Project, the intake location was selected so as to withdraw water from a depth at which there was a 99% confidence that the temperature would not exceed 39°F. These criteria required that the intake be constructed at a distance of approximately 22,400 linear feet from shore (approximately 23,400 linear feet from the Lake Water Pumping Station) to withdraw water from depths approaching 300 feet.

*Design flow rates:* To provide sufficient capacity to satisfy Cold Water District and Monroe County Water Authority demands, the lake water supply system will be designed to provide a maximum (peak day) flow rate of 100 mgd with provisions for future expansion to an ultimate capacity of 150 mgd. The currently anticipated peak capacity increments are summarized as follows:

**Table 2-5.** *Lake water supply system - Peak capacity increments.*

| | Phase 1 | Phase 2 | Phase 3 | Ultimate |
|---|---|---|---|---|
| MCWA-Water Treatment Plant | 20 mgd | 50 mgd | 100 mgd | 150 mgd |
| Cold Water District | 100 mgd | 100 mgd | 100 mgd | 150 mgd |
| Lake Water Supply System | 100 mgd | 100 mgd | 100 mgd | 150 mgd |

The expansion of the water treatment plant will be implemented by the MCWA based on periodic review of existing and projected demands within the service area. The capacity increments identified represent logical capacity increases assuming the new water treatment plant will be developed in a manner similar to the MCWA's existing Shoremont water treatment plant.

Based on the cooling load information presented in Table 2-1, Table 2-2, and information previously provided by the MCWA, it is anticipated that the potable water and cooling water flow rates will vary as follows:

CONCEPTUAL DESIGN **FIGURE 1**

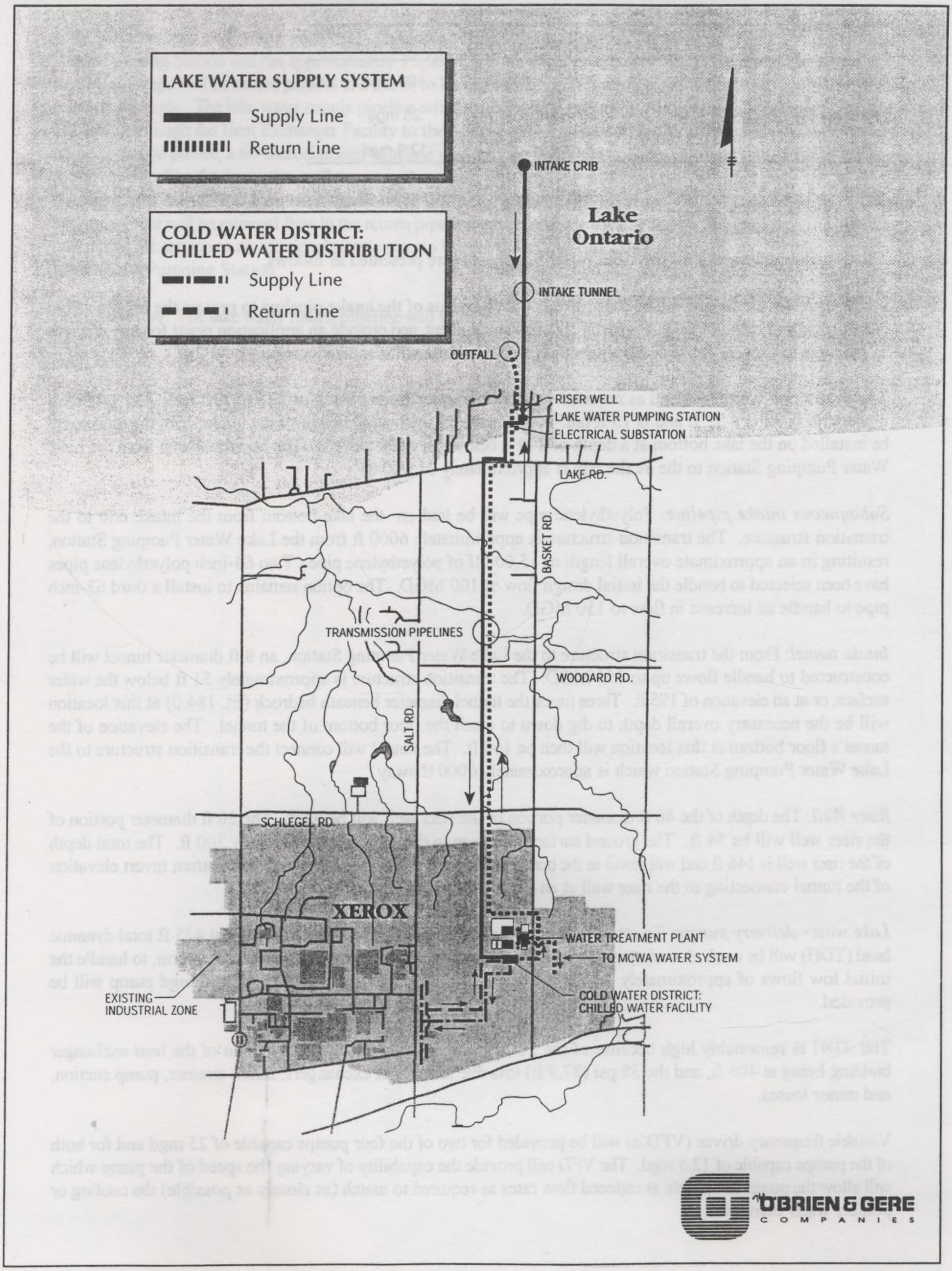


Table 2-6. *Lake water supply system - Design flow rates.*

| | Potable Water | Cooling Water |
|---|---|---|
| Peak hour | 20 mgd | 100 mgd |
| Average day | 10 mgd | 25 mgd |
| Minimum hour | 8 mgd | 12.8 mgd |

### 2.2.2 Design requirements

The design requirements for the Lake Water Supply side are presented as follows.

*Intake Crib:* An intake crib will be constructed at the terminus of the intake pipeline to protect the pipeline from debris, minimize entrance velocities to mitigate fish entrainment, and provide an application point for low dosages of oxidants to prevent zebra and quagga mussel colonization at the intake location.

The intake crib will be located as required to withdraw water from a depth of 225 to 230 feet. The proposed intake crib is 32 ft x 32 ft and is 15 ft tall. Accounting for the overall height of the intake crib, the intake will be installed on the lake bottom at a depth of 240 ft below the water surface. The horizontal run from the Lake Water Pumping Station to the intake crib is approximately 21,000 lf.

*Subaqueous intake pipeline:* Polyethylene pipe will be laid on the lake bottom from the intake crib to the transition structure. The transition structure is approximately 6000 ft from the Lake Water Pumping Station, resulting in an approximate overall length of 15,000 lf of polyethylene pipe. Two 63-inch polyethylene pipes have been selected to handle the initial design flow of 100 MGD. The option remains to install a third 63-inch pipe to handle an increase in flow to 150 MGD.

*Intake tunnel:* From the transition structure to the Lake Water Pumping Station, an 8 ft diameter tunnel will be constructed to handle flows up to 150 MGD. The transition structure is approximately 51 ft below the water surface, or at an elevation of 195 ft. Three times the tunnel diameter beneath bedrock (El. 184.0) at this location will be the necessary overall depth to dig down to reach the floor bottom of the tunnel. The elevation of the tunnel's floor bottom at this location will then be 160 ft. The tunnel will connect the transition structure to the Lake Water Pumping Station which is approximately 6000 lf away.

*Riser Well:* The depth of the 40 ft diameter portion of the riser well will be 92 ft. The 20 ft diameter portion of the riser well will be 54 ft. The ground surface elevation in this area is approximately 300 ft. The total depth of the riser well is 146 ft and will result in the bottom of the riser well being flush with the bottom invert elevation of the tunnel connecting to the riser well at an elevation of 154 ft.

*Lake water delivery pumps:* To attain 100 mgd, 4 main pumps each rated for 25 mgd at 425 ft total dynamic head (TDH) will be used. A backup pump with the same rating will be also provided. In addition, to handle the initial low flows of approximately 12.8 mgd, one 12.5 mgd pump and one backup 12.5 mgd pump will be provided.

The TDH is reasonably high because of the 70 ft seal weir tank, the 405 ft elevation of the heat exchanger building being at 405 ft, and the 38 psi (87.7 ft) loss due to the heat exchangers, micro strainer, pump suction, and minor losses.

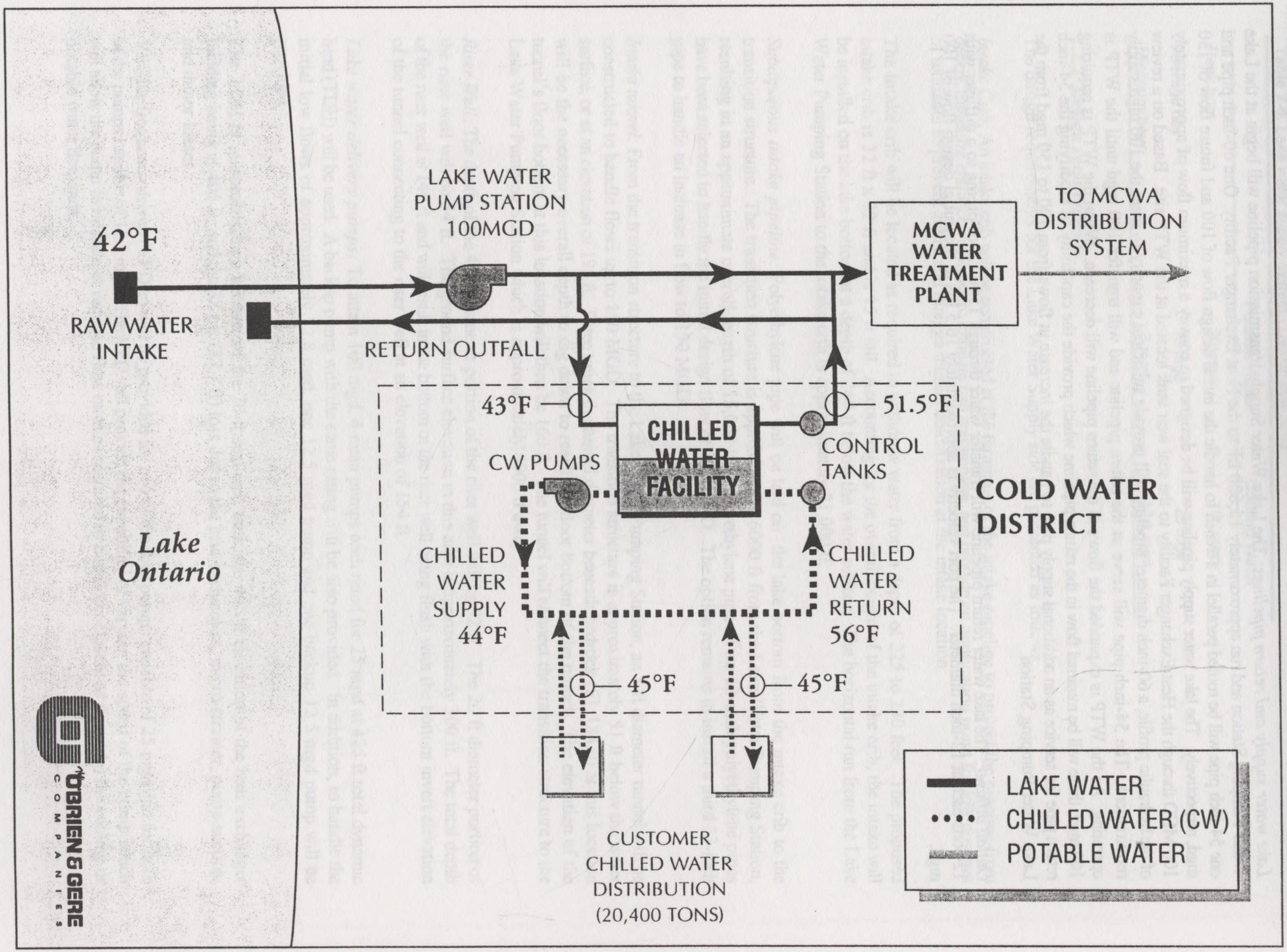
Variable frequency drives (VFD's) will be provided for two of the four pumps capable of 25 mgd and for both of the pumps capable of 12.5 mgd. The VFD will provide the capability of varying the speed of the pump which will allow the pump to operate at reduced flow rates as required to match (as closely as possible) the cooling or potable water demands.

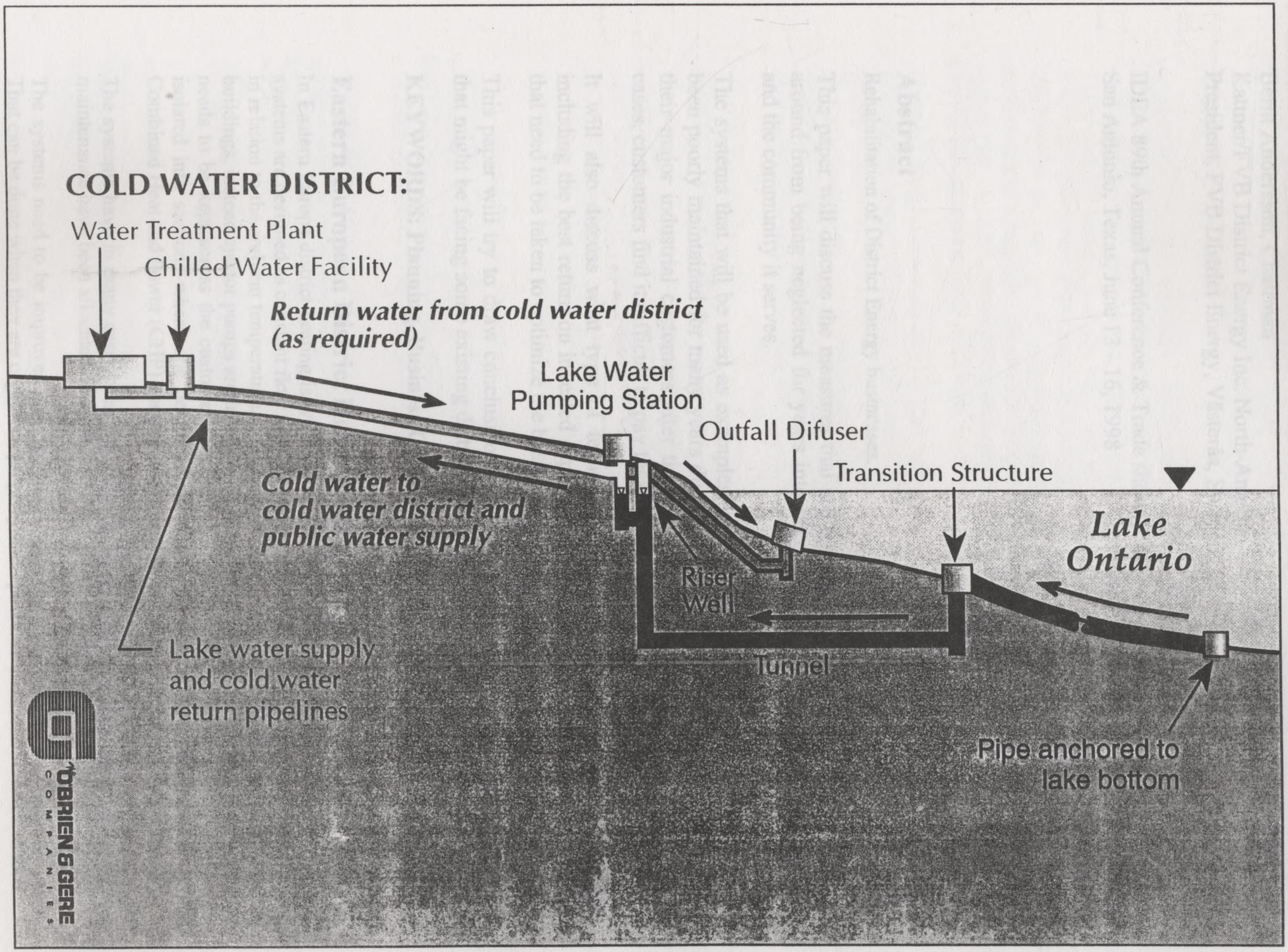
*Lake water supply and return pipelines:* The Lake Water Supply transmission pipeline will begin at the Lake Water Pumping Station and run approximately 15,600 LF to the Heat Exchanger Facility. One 60-inch pipe and one 54-inch pipe will be routed parallel in a trench to handle the initial design flow of 100 and future flow of 150 mgd, respectively. The lake water supply pipeline will be designed to convey a maximum flow of approximately 100 MGD through the Heat Exchanger Facility to the seal weir tank located at the WTP site. Based on a review of the hydraulic profile, a 60-inch diameter pipeline will provide sufficient capacity to meet the 100 mgd supply requirement. The 54-inch pipe will serve as the return pipeline and will transfer 100 mgd until the WTP is operating. As the WTP is expanded the flows in the return pipeline will decrease. When the WTP is requiring 100 mgd, there will be minimal flow in the return pipeline which provide the capability of modifying the 54-inch return pipe for service as an additional supply pipe to handle the increase in flows from 100 to 150 mgd from the Lake Water Pumping Station.

*Outfall diffuser:* The lake water return pipeline will transfer water through 1500 LF of piping to a diffuser with 12 ports each at 12-inch diameter. The port velocity is approximately 16.5 fps at the initial design flow of 100 mgd.

## PROCESS FLOW SCHEMATIC

FIGURE 2






SYSTEM PROFILE FIGURE 3