Engineering Report for the City of Cleveland, MO

presented to the

City of Cleveland and the Missouri Department of Natural Resources

14 January, 2000

$H_2O'C$, Limited
2401 Tahoe Court
Columbia, MO 65203-1444

(573) 446-5595
john@h2oc.com

Table of Contents

Statistical Summary

City of Cleveland
PO Box 68
Cleveland, MO 64734
(816) 618-3412

Government:	Mayor Gerald D. Aksamit; Six-member City Council
Population:	580; 218 service connections
Water Supply:	Regional: Up to 100,000 gpd of Kansas City, Missouri, finished water purchased through Cass County Public Water Supply District #2 as of October 4, 1999
Pressure:	120 psi at incoming 8” main, reduced to 65 psi at meter box
Water Use:	38,000 gpd avg (1997), 60,000 gpd peak
Storage:	248,000 gallons (60,000 gal. clear well + 188,000 gals in two standpipes)
Distribution:	2” ABS; 2”, 4”, 6” PVC and 4” Cement Asbestos (Transite) pipes
Water Loss:	0 % ‘unaccounted for’ (November,1999 data)
Rates:	$17.00 / first 1,000 gallons; $8.50 / 1,000 gallons thereafter; $850 connection fee
Budget:	Established annually by City Council; No water system bonds outstanding.
Operation:	Part-Time, Class C licensed water treatment plant operator
Concerns:	Distribution System - undersized, brittle, antiquated pipes; breakage; water loss Storage - unequal elevation of standpipes; system pressures Water Rates - increased from previous rates due to new water source Water Conservation - methods to reduce impact of new water rates

Regional Drinking Water Source

On October 4, 1999, the City of Cleveland ceased operation of its 40-year-old treatment plant and began purchasing potable water from Cass County Public Water Supply District #2. The Cass County PWSD #2 receives and redistributes lime softened, filtered, fluoridated and disinfected water from the Kansas City, Missouri water treatment plant, located in North Kansas City, Missouri.

The Kansas City treated drinking water supply, 75% of which is derived from the Missouri River and 25% of which is withdrawn from the alluvial flood plain of the Missouri River, has consistently been in compliance with state (MDNR) and national (USEPA) drinking water standards. As a result of softening, the water is relatively stable with respect to calcium carbonate deposition. It is also comparatively non-corrosive due to its alkaline pH. Overall, the water does not tend to create excessive deposits in household appliances or readily corrode household plumbing. Careful control is exerted over the fluoride concentration in the Kansas City finished water and extensive new storage facilities have been constructed to ensure that the disinfection process is complete before the water leaves the treatment plant clear well and enters the distribution system.

Overall, the Kansas City water supply receives comprehensive, multi-stage treatment. The water treatment plant operation and maintenance staff is supported by extensive chemical and microbiological analytical facilities which are housed in modern laboratories on the plant site. The plant operational staff are highly qualified and certified by appropriate certifying agencies. An illustrated brochure describing the process used at the Kansas City water treatment plant is included in the Appendix.

The Kansas City water department also maintains a highly qualified staff to operate and maintain their extensive distribution system. Main breaks, water losses due to leakage and changes in water quality during distribution are addressed by the water distribution division of the water department. Their task is to ensure that adequate quantities of water are available at adequate pressures at all locations in the system and that water quality is not compromised by broken pipes, cross-connections or back-siphonage.

In connecting to the Kansas City water treatment and distribution system through the Cass County PWSD #2, the City of Cleveland has avoided substantial costs associated with the increasingly stringent requirements of the Safe Drinking Water Act. It has done so by encompassing the operational, managerial and laboratory resources which are only available through a large, centralized drinking water supply system. In water supply, as in most industries, the unit cost of production is strongly related to economies of scale.

The reported consumer reaction to the quality of the new water source has been positive. Only the increased cost of the new supply has generated comment.

Water Treatment Plant (Abandoned)

As a result of purchasing water from Cass County PWSD #2, Cleveland need not replace or significantly upgrade its antiquated treatment facility.

The water plant has been utilized to the maximum extent of its useful life, and the expenditure required to make it capable of meeting drinking water quality regulations, including reduction of trihalomethanes, would increase water production costs well beyond current rates.

While little of the treatment plant equipment can be salvaged or sold, the plant finished water reservoir can still provide 60,000 gallons of ground-level water storage. Two pumps are available for delivering this stored water to the system at a rate of 205 gpm. It is anticipated that these redundant facilities will be removed.

Lake Water Source (Abandoned)

The lake water reservoir, which once served as the drinking water source, is no longer needed for water supply. Owing to its proximity to the community and its use since 1975, this water body may continue to serve as a recreational resource, providing a pleasant, wooded area for angling, picnicking, hiking, jogging, bird-watching and contemplation. It is unlikely that the lake will be returned to service as a water supply source.

Water Demand

Previous Water Use

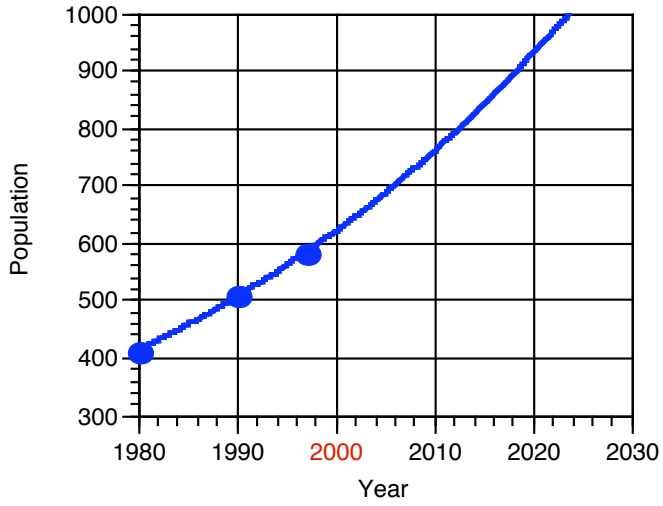
Patterns of municipal water use vary widely with season, temperature, day of the week, water costs, system pressures and, even, community size and affluence. Peak demands usually occur in the summer, particularly during droughts, when maximum daily pumpage may be greater than 3-4 times the average daily flow. For distribution system design purposes, fire demands may be superimposed on the peak hour which may exceed 5 times the average daily flow.

In 1997, Cleveland's average daily pumpage for 208 customers (service connections) was recorded as 38,000 gpd in the winter and 60,000 gpd in the summer. The estimated 1997 population of 580 consumed about 66 to 103 gallons per capita per day and averaged 2.8 persons per service connection.

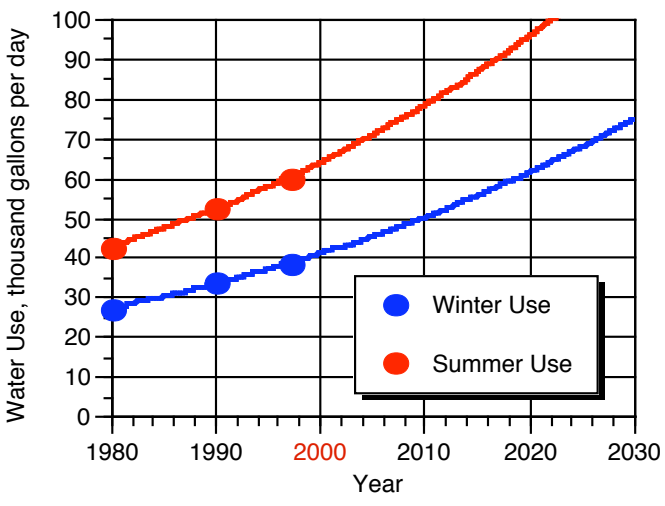
Projected Water Use

Based on the available population data, projections have been made of future population and water use. A gradually-increasing rate of population growth would bring Cleveland's population close to 1,000 by 2020. If per capita consumption remained at 66 to 103 gpd, peak summer daily demands would be near the 100,000 gpd maximum figure specified in the City's contract with Cass County PWSD#2 at approximately this time.

Population Projection: Cleveland, MO

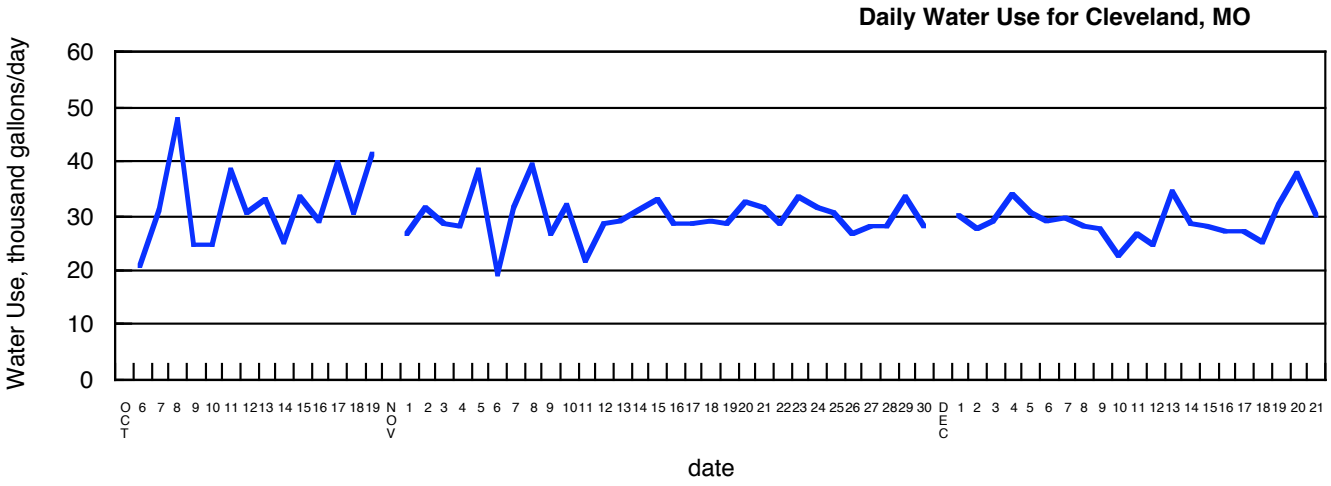


Projected Water Use: Cleveland, MO



Current Daily Use

Since the increase in water rates is expected to have an effect on water usage, daily consumption has been monitored since Cleveland converted to its new source. These first data, plotted below, indicate an average daily consumption of about 32,000 gpd. A significant portion of this apparent 16 percent decrease in average water consumption has been attributed to the elimination of water use for filter washing and maintenance at the now-abandoned water treatment plant.



Meeting Future Water Needs

Progressive increases in the amount of water consumed by the City of Cleveland can now be accommodated by increasing the amount of water purchased up to the present negotiated limit of 100,000 gallons per day. Additional needs beyond that quantity can be negotiated as those needs develop. This option eliminates the need for substantial capital investments for step-wise increases (usually, a doubling) in water treatment plant capacity. It also allows for payment for additional water capacity to be met by City water users as they create the demand. As a result, projections of future water use, often based on speculation with regard to anticipated development and future economic conditions, are now less critical for Cleveland.

Distribution and Storage

With major issues of water availability for growth and development resolved, the primary issues for Cleveland's water supply are related to the City-owned water distribution system. Redundant elevated storage, the control of system pressures, the availability of water for fire fighting and system flushing, and the maintenance of water quality during distribution are now among the City's principal water concerns and responsibilities.

Fire Protection

There are important operational and managerial benefits associated with the conversion to Cleveland's new regional water source. First, the pressure at the point of connection to Cass County Public Water Supply District #2 is high (~120 to 125 psi). This has resulted in improved water pressures and higher potential fire flows throughout the distribution system. System pressure testing by the Insurance Service Organization (ISO) may aid in obtaining an improved fire fighting classification and potentially lower fire insurance rates.

Currently, Cleveland is rated as a Class 5 (out of 10) risk. Class 5 requires flows of 250 gpm for 2 hours at a minimum pressure of 20 psig. Computer-based hydraulic modeling indicates that higher flows can now be sustained for longer periods at higher pressures.

Elevated Storage

Elevated storage tanks are used to provide water for periods of peak water use and to maintain system water pressures. Formerly, all Cleveland's water was pumped into the distribution system and into elevated storage during periods of low water use, generally, at night. During peak daytime use, the water was delivered both by pumping from the treatment plant clear well and by gravity flow from the standpipes.

After connection to the Cass County PWSD #2 elevated storage tank, all Cleveland's water flows to its distribution system by gravity. Pumping from the Cleveland treatment plant clear well is no longer necessary. This results in a savings in electrical power costs. The 0.5 million gallon Cass County PWSD #2 elevated storage tank should provide additional security to ensure the availability of water both to meet fire needs and maintain service during power outages.

Previously, Cleveland utilized two standpipes for elevated storage. The older, 90-foot tall, 14-foot diameter, Lone Pine Subdivision (south) standpipe is presently in need of routine maintenance. This would involve cleaning, sandblasting and painting with epoxy coating. However, when filled, the water elevation in the Lone Pine Subdivision (south) standpipe is approximately 36 feet lower than the top of the 100-foot tall, 12-foot diameter, Lazy Y Subdivision (north) water storage facility. Therefore, consideration had been given to increasing the height of the south standpipe to match the height of the north standpipe.

The north standpipe, acquired by purchase from the Cass County Public Water Supply District #7 in 1997, allowed Cleveland to provide additional storage capacity required to meet Missouri Department of Natural Resources' (MDNR) recommendation that finished water storage be, at least, equal to the average daily demand (MDNR *Public Drinking Water Program Design Guide for Community Water Supplies*). As an added benefit, addition of the north standpipe increased water pressures throughout the Lazy Y portion of the distribution system.

The approximately 36-foot difference in elevation between the two standpipes complicated the hydraulics of the Cleveland distribution system in that, if both tanks were filled to capacity, water would tend to flow from the north to the south standpipe. As illustrated in the attached figure in the Appendix, the north standpipe was not filled to capacity, but only to the same level as the south standpipe.

The City of Cleveland has solicited and received an estimate of approximately $100,000 as the cost of cleaning, painting and raising the south standpipe by 26 feet. This expenditure would provide an additional 52,000 gallons of storage in the north and south standpipes. Cleveland would then have a usable finished water elevated storage capacity of approximately 60,000 gallons at a minimum pressure of 40 psi at the Lone Pine Subdivision standpipe and 30 psi at the Lazy Y Subdivision standpipe.

As noted, Cleveland currently has 60,000 gallons of ground storage at the site of the old water treatment plant. Two pumps are available at this site. According to a 1997 Engineering Report (Samuel Styron, Consulting Engineer), the combination of these pumps can deliver 205 gpm at a head of 175 feet (76 psi). With this facility in service, available on-line storage increases to 120,000 gallons, or a total of over three days average daily water use.

In summary, Cleveland could conceivably provide water to their distribution system from four separate inflows, as indicated in the following table. However, under normal conditions, the influent from Cass County PWSD #2 will provide all the system needs. As a result, the remainder of Cleveland's storage would remain essentially stagnant unless operated on a daily basis to increase water standpipe turnover or to provide for main flushing or emergency use.

Source	Pressure, psi	Storage, gallons	Operational Status
Cass County PWSD #2	120 > 65	500,000	open / pressure regulated at 65 psi
Lone Pine Standpipe	39	104,000	closed / abandoned
Lazy Y Standpipe	28 (Min.) - 41 (Max.)	85,000	open during day / closed at night
Ground Storage	76 (pumped)	60,000	closed / abandoned

Regulation of System Pressures to avoid Stagnation

The pressure regulating valve (PRV) at the influent meter box has been adjusted to approximately 65 psi in order to maintain system pressures of 40 psi or greater throughout Cleveland. However, such consistently high system pressures will not permit significant daily withdrawal and replenishment (turnover) of water in the Lazy Y standpipe. To avoid stagnation, it is recommended that at least one-quarter of stored water be withdrawn daily.

A system input valve just downstream from the PRV should be telemetrically controlled to allow daily variations to occur in the elevation of water stored in the Lazy Y standpipe. When the water level in the standpipe reaches 95 feet, the system input valve should close, allowing water from the standpipe to feed the distribution system. When the water level in the standpipe drops to 65 feet, the system input valve should open, allowing the incoming water from Cass County to refill the standpipe. High influent flow rates to refill the standpipe will create turbulence and thereby increase the degree of mixing within the tank.

Distributed Water Quality

The preservation of water quality during distribution may be an aesthetic problem in some areas. However, the increased stability and alkaline reaction of the water produced at the Kansas City water plant may moderate problems of corrosion and discolored water. A year of usage and continued flushing may be required to determine whether “brown water” complaints have been mitigated.

Past consumer complaints have come from areas referred to as ‘dead ends’ which are areas where water retention times are long and disinfectant residuals are generally low or absent. To minimize such problems, the recommendations for replacement mains have been guided by the criterion that water should be provided to consumers within four days travel time in the distribution system.

Recommendations for improvements to the distribution system are presented on a revised schematic. Whereas significantly larger pipe would allow for expansion in water use at comparatively small incremental installation cost, attention has been given to modeling the influence of the replacement pipe size on distribution residence times. Excessive residence times in distribution mains may sometimes lead to water stagnation, evidenced by the loss of disinfectant residuals, the depletion of dissolved oxygen, and the development of odor-producing, anaerobic microbial growths.

The delivery of water containing a disinfectant residual to each household is a basic requirement of distribution system water quality protection. A persistent disinfectant residual is considered to provide protection against the intrusion of pathogenic organisms from backsiphonage or cross-connections.

Existing Treatment and Storage Facilities

The existing water treatment facilities are redundant and should be dismantled. While there may be some benefit in preserving the water storage and pumping facilities at the plant site for potential emergency use, infrequent use will ultimately result in deterioration and operational problems. These facilities should be retained only if Cleveland's fire insurance classification benefits from their maintenance. Otherwise, it is recommended that all treatment, storage and pumping systems be dismantled. Approximately $30,000 should be budgeted for the removal and disposal of the abandoned water plant facilities.

Hydraulic system modeling has shown that adequate pressures should be available throughout the Cleveland distribution system under all conditions of normal and peak domestic use. The presence of Cleveland's standpipes merely serves to provide additional safeguards for emergency needs. Since it is not hydraulically optimal in terms of utilization of the maximum storage capacity of the two standpipes, there does not appear to be any significant benefit in expending $100,000 for renovating and raising the height of the Lone Pine standpipe.

Hydraulic modeling indicates that removal of the Lone Pine standpipe will reduce the maximum fire flow attainable in the extremities of the Lone Pine Subdivision. This will be partially offset by filling the Lazy Y standpipe to its capacity (approximately 30 feet higher than at present). Since continued use of the Lone Pine standpipe would involve the elevated storage of stagnant water, it is recommended that the Lone Pine standpipe be drained and removed from service and the Lazy Y standpipe be filled to capacity. If desired, the Lone Pine standpipe may be physically removed at an estimated cost of $8,000.

Main Replacement Program

Cleveland has systematically been replacing undersized and brittle ABS plastic pipe installed almost half a century ago. Much of this pipe is only two inches in diameter and unable to deliver the minimum flows required for fire fighting. Since installation of ABS has declined nationally, replacement parts and fittings are increasingly difficult to locate. Currently, four-inch diameter pipe is considered by the Insurance Services Office to be the minimum size suitable for meeting basic fire-protection requirements. The MDNR Design Guide states that "the minimum size of a water main for providing fire protection and serving fire hydrants shall be six inches in diameter." In recent years, it has been Cleveland's general policy, when replacing undersized mains, to use a minimum of six-inch PVC pipe.

Distribution System Map

A schematic of Cleveland's distribution system has been updated and is included in the Appendix. This drawing was created with the assistance of Darvin Schildknecht, system operator and former City Council member, who has an in-depth knowledge of the location and condition of the existing infrastructure as a result of his long-term work in operating and maintaining the Cleveland water treatment and distribution system.

Cleveland's distribution system has been superimposed on a topographic map showing the location of streets and buildings. For reference, the estimated location of Cleveland's city limits has been superimposed on the map.

The distribution system map shows the approximate location of hydrants, valves, standpipes, the abandoned water plant, and former lake water source. The existing distribution mains are shown in black (2" diameter ABS), yellow (4" diameter CA), and blue (PVC).

Cleveland's two-inch lines are highlighted to indicate the areas of needed upgrade to a larger pipe size. In addition to enhanced fire-fighting protection, the replacement of these lines will reduce the labor costs associated with breakage due to pipe embrittlement. In accordance with Cleveland's current practice, it is anticipated that replacement piping will also be plastic (polyvinyl chloride) since PVC pipe is less likely to generate corrosion products or provide rough surface niches which will support microbial growths. Moreover, PVC plastics remain flexible and have a greatly reduced tendency to become brittle, puncture or rupture. As a result of a systematic program of replacement, only approximately 3,250 feet of ABS pipe remain to be replaced in the Cleveland system.

Subsequently, the main replacement program should also seek to eventually eliminate those mains which are made of cement-asbestos (CA). Cement-asbestos pipe, or *Transite* (a Johns-Manville Corporation trade name), was made with asbestos fibers embedded in a hard and smooth, but brittle, matrix of calcium carbonate. CA pipes tend to rupture when subjected to heavy surface loads or soil movement. There has also been some concern that, where waters are acid, the carbonate matrix will be

dissolved and asbestos fibers will be released into the distributed water. The latter should not be a concern for the City of Cleveland since it has never had acid water in its mains. There are approximately 3,159 feet of CA pipe in the Cleveland system.

Finally, there are 5,474 feet of two-inch PVC pipe in the system which may be replaced with six-inch PVC as resources permit. This will provide additional fire protection in the region served.

Based on Cleveland's past experience with excavation, installation, hydrant and valve replacement plus connection costs, the projected main replacement costs have been estimated, as follows:

Existing Main / Length	Replacement	Location	Est. Total Cost
Two-inch ABS / 2600 feet	6" PVC	North 3rd, Cleveland, Hennon	$84,000
Two-inch ABS / 650 feet	4" PVC	Alley, east of South 5th St.	$6,000
Four-inch CA / 3159 feet	6" PVC	Central Area	$110,000
Two-inch PVC / 1374 feet	6" PVC	South 5th Street	$40,000
Two-inch PVC / 4100 feet	6" PVC	East of Route "D"	$150,000
Total: 11,883 feet			**$390,000**

Main Replacement Priorities

1. The 2,600 feet of 2" ABS pipe on North Third, Cleveland, and Hennon Streets should be replaced with 6" PVC pipe. Hydrants and valves should be installed. Estimated cost: $84,000.

2. The 650 feet of 2" ABS pipe in the alley east of South Fifth Street should be replaced with 4" PVC pipe. Estimated cost: $6,000.

3. The other main replacement projects listed in the previous table should be undertaken when main breaks become more frequent and as financing permits.

Dead Ends

There are several dead ends in the Cleveland system. All dead ends of 6" mains (i.e., northernmost point of the Lazy Y subdivision; both endpoints of the Meadowbrook subdivision) are equipped with fire hydrants. Since the southwestern dead end in Lone Pine is only a 4" pipe (and therefore not a candidate for a fire hydrant according to MDNR's Design Guide standards), it should be equipped with a flushing hydrant or blow-off for flushing purposes. At the time the 2" main east of Route D is upgraded to 6", fire hydrants should be installed at each end.

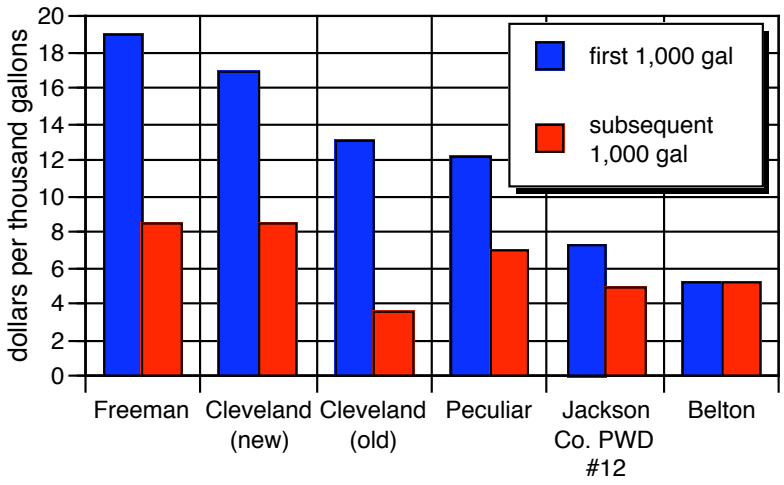
Although not necessary or practical at the present time, consideration should be given to future looping of water mains north of town as this area is developed (between Lazy Y and Meadowbrook) as part of a long-term strategy.

Financial Aspects of System Operation and Management

Since uncertainty exists as to the annual costs of operating Cleveland's water system using the new water source, the City Council has set new rates it believes will provide sufficient revenue to pay for the water consumed plus fund needed improvements to the distribution system. Council members have some concern that water use will decrease because of these increased rates. Thus, revenues would fail to meet that required to maintain the water system.

Comparative Water Rates

Comparative 1999 water rates for Cleveland and several nearby water suppliers are shown in the adjacent figure.



At $17.00 for the first 1,000 gallons and $8.50 for each 1,000 gallons thereafter, Cleveland's new rates are generally higher than those currently in effect in surrounding communities. The water service connection fee is $850.

Annual Water System Budget

Water systems continually require operation, maintenance, upgrading and extension, particularly in a growing community. Annual budgets may provide accruals for capital improvements, such as main replacement and standpipe maintenance. Cleveland currently has no contingency funds for these future expenses. Provision must also be made for such non-recurring expenditures as plant demolition and standpipe removal.

One year of experience with the existing rate structure may enable the City Council to determine if the newly-established rates are equitable or require modification.

Financial Analysis	
cost of water from supplier ($/1,000 gal)	$4.25
service connections	218
gal/connection/month	4,400
average water usage (gal/month)	959,200
water rates, first 1,000 gal	$17.00
water rates, subsequent 1,000 gal	$8.50
INCOME (monthly)	
average bill	$45.90
total revenue	**$10,006**
EXPENSES (monthly)	
average cost of water sold	$4,077
operation and maintenance (estimated)	$1,500
administrative services (estimated)	$1,000
total expenses	**$6,577**
total income minus expenses	$3,430

Water System Operation and Maintenance

Operation and maintenance of Cleveland's water system is conducted by Darvin Schildknecht, a Class C certified operator, and his assistant. In 1999, the salaries paid were $14,950 to the system operator and $9,710 to his assistant. Based on these numbers and estimated routine expenditures, the monthly system operational cost has been estimated at $2,500.

Diligent attention to the system is evident. The now-abandoned water plant was kept operational despite age and deterioration of many components. Water losses in the distribution system appear to be minimal. Overall, the water system appears to be well-maintained and well-operated.

Grants and Loans

Several state and federal agencies administer grant and loan programs to assist communities with financing improvements to their infrastructure. In general, top priority is given to those communities with financial need and threats to public health.

USDA

The United States Department of Agriculture Rural Utilities Service Water and Waste Disposal Systems Grants & Loans Program (Rural Development) allocates approximately $25 million per year for improvements to rural water and wastewater systems. In 2000, 67% of these funds will be allocated for loans and 33% for grants.

classification	*grant / loan*	*interest rate*	*median household income*
poverty	75% grant	3.25% apr	< $20,272
intermediate	50% grant	4.375% apr	$20,273-$25,694
market rates	no grant	5.5% apr	> $25,695

According to the 1990 census, Cleveland's median household income is $31,250, placing the City well above the grant eligibility level. In addition, Rural Development assigns a lower priority to proposals which request grant funds and involve fire flow design.

Although not a candidate for grant money, the City may be eligible for loans for system improvements at the 5.5% interest rate. However, Rural Development Policy goes on to state that "Applicants must be unable to finance the proposed project from their own resources or through commercial credit at reasonable terms and rates."

MDNR

The Missouri Department of Natural Resources oversees the Drinking Water State Revolving Loan Fund. These monies are loaned to communities based on the following point-based Priority Ranking Criteria:

- Safe Drinking Water Act Compliance
- Public Health (waterborne disease outbreak, inadequate water supply or pressure)
- Affordability (median household income, ratio of 5,000 gallon water bill to MHI)
- Additional (natural disasters and consolidation).

Again, Cleveland's high median household income and adequate supply and pressure of high-quality water suggest that the City would not be a priority candidate for this money.

Water Conservation

While the switch to a new water supply appears to have been well-received by residents, comments have been received regarding the increases in water rates. There has been speculation that higher water rates would result in reduced consumer water usage to offset the increased costs. Therefore, H_2O'C was asked to evaluate water system losses and rates.

Since the cost of water to the City of Cleveland is based on total usage, including losses, efforts have been made to locate and eliminate distribution system leakage and minimize 'unaccounted for' water. The October-November, 1999 data from metering the water purchased from Cass County and comparing it with water use data indicates that there is very little water loss from the Cleveland system. This first estimate indicates water loss is essentially zero. The MDNR estimates that Missouri utilities average 12% 'unaccounted for' water. Nationally, losses of 25% to 30% and more are not uncommon.

Cleveland consumers may benefit economically from a water conservation education program. Relevant studies were conducted by the University of Missouri-Columbia, Department of Civil Engineering, in 1980 at Springfield, the only Missouri city to have a 'Peak Day Water Conservation Plan'. The results indicated that 90% of consumers believed that water conservation was necessary, even in a 'water-rich' state. While only 15% had installed water conservation devices, 64% were consciously trying to conserve water.

The installation of passive faucet and shower flow controls plus toilet tank barriers in 55 Springfield homes resulted in an estimated 19% annual reduction in water use. The annual financial savings from reduced water use for 'large' (two or more bathrooms) homeowners was calculated at $38.74 (1980) for water, $41.36 for energy and $14.36 in reduced sewer tax. Energy savings were based on heating costs for hot water. The cost of heat loss from the ambient heating and subsequent discharge of toilet tank water was not estimated, but could also be significant.

As part of the project, billing 'stuffers' providing water-saving tips for the homeowner were prepared for distribution by MDNR. Copies for distribution to consumers should still be available upon request.

In addition, the City of Springfield made water conservation kits containing flow restrictors and toilet tank barriers available to all their consumers, free of charge. These were distributed throughout the City, at such locations as shopping malls.

Computer Modeling of Cleveland Water Distribution System

Hydraulic modeling software released by USEPA (EPANet beta v2.0) has been used to estimate the hydraulic characteristics of the Cleveland distribution system.

Based on information provided by Darvin Schildknecht and from previous engineering studies, data for the Cleveland water distribution system was entered into the model. Simulations were run under various scenarios to determine system pressures and flows under a range of assumed water use and operational conditions. The impact of connecting to the Cass County PWSD #2 on Cleveland's existing water standpipes was observed over extended periods for average and peak demands.

The computer simulations indicate that pressures may be expected to be adequate (50 to 75 psi) throughout the distribution system under normal system operation. Simulations involving fire flows of 250 gpm and two-hour duration indicate that minimum pressures of 20 psi will maintained at all points in the system, with the exception of those points currently fed by 2" mains. Previously in this report, it was recommended that these small mains be replaced with larger pipe.

Schematic diagrams of the Cleveland distribution system under normal and fire flow conditions have been prepared and appear on the following pages.

Summary of Recommendations

A system input valve just downstream from the PRV should be telemetrically controlled to allow daily variations to occur in the elevation of water stored in the Lazy Y standpipe. When the water level in the standpipe reaches 95 feet, the system input valve should close, allowing water from the standpipe to feed the distribution system. When the water level in the standpipe drops to 65 feet, the system input valve should open, allowing the incoming water from Cass County to refill the standpipe.

The existing water treatment facilities are redundant and should be dismantled.

The Lone Pine standpipe be drained and removed from service and the Lazy Y standpipe be filled to capacity. If desired, the Lone Pine standpipe may be physically removed at an estimated cost of $8,000.

Since the southwestern dead end in Lone Pine is only a 4" pipe (and therefore not a candidate for a fire hydrant according to MDNR's Design Guide standards), it should be equipped with a flushing hydrant or blow-off for flushing purposes. At the time the 2" main east of Route D is upgraded to 6", fire hydrants should be installed at each end.

Main Replacement Priorities

1. The 2,600 feet of 2" ABS pipe on North Third, Cleveland, and Hennon Streets should be replaced with 6" PVC pipe. Hydrants and valves should be installed. Estimated cost: $84,000.

2. The 650 feet of 2" ABS pipe in the alley east of South Fifth Street should be replaced with 4" PVC pipe. Estimated cost: $6,000.

3. The other main replacement projects listed in the table on page 13 of this report should be undertaken when main breaks become more frequent and as financing permits.