Task A: A Review of Previous and Ongoing Studies, DWSD Policies and Regulations Related to DWSD Comprehensive Water Master Plan

Comprehensive Water Master Plan
DWSD Contract No. CS-1278

Final Report

For Submittal to

Detroit Water and Sewerage Department

March 2002

CH2MHILL

IN ASSOCIATION WITH CDM

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Acronyms and Abbreviations

ADD	Average Daily Demand
AL	Action Level
AMCL	Alternative Maximum Contamination Level
AMWA	Association of Metropolitan Water Agencies
APD	Average Population Density
AWWA	American Water Works Association
BCCs	Bioaccumulative Chemical of Concerns
BG	Billion Gallon
BGD	Billion Gallon per Day
CCL	Contaminant Candidate List
CIP	Capital Improvement Plan
COP	Current Operating Parameters
CROMERRR	Cross-Media Electronic Reporting and Record-Keeping Rule
CSO	Combined Sewage Overflow
CSTR	Completely Stirred Tank Reactors
CT	Contact Time
CWA	Clean Water Action
CWMP	Comprehensive Water Master Plan
CWSMP	Conceptual Water Master Plan
DBP	Disinfection by-products
D/DBPR	Disinfectants/Disinfection By-Products Rule
DWSD	Detroit Water and Sewage Department
ESWTR	Enhanced Surface Water Treatment Rule
FACA	The Federal Advisory Committee
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
GCDC	Genesee County Drain Commission
GCPC	Genesee County Planning Commission
GLI	Great Lakes Initiatives
GLWQA	Great Lakes Water Quality Agreement
IESWTR	Interim Enhanced Surface Water Treatment Rule
IJC	International Joint Commission
LaMP	Lakewide Management Plans
LCPC	Lapeer County Planning Commission
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminate Level Goal

MDEQ	Michigan Department of Environmental Quality
MDBP	Microbial and Disinfectant Byproducts
MG	Million Gallon
MGD	Million Gallon per Day
MMM	Multimedia Mitigation Program
NAS	National Academy of Sciences
NODA	Notice of Data Availability
NPDES	National Pollution Discharge Elimination System
NSC	North Service Center
OEI	EPA's Office of Electronic Information
OPMA	Office of Program Management Assistance
OPP	Office of Pesticide Programs
PAC	Powered Activated Carbon
PCB	Polychlorinated Biphenyls
pCi	One trillionth of a curie (10-12 Ci)
PSW	Partnership for Safe Water
PWS	Public water System
RAP	Remedial Action Plan
RUC	Restricted Use Classification
SCC	System Control Center
SCD	Streaming Current Detectors
SDP	System Design Parameters
SDWA	Safe Drinking Water Act
SEMCOG	Southeast Michigan Council of Governments
SFR	Drinking Water State Revolving Fund
SWAP	Source Water Assessment Program
SWQD	Surface Water Quality Division
TAZ	Traffic Analysis Zone
TCR	Total Coliform Rule
UCMR	Unregulated Contaminant Monitoring Rule
USEPA	United States Environmental Protection Agency
WQC	Water Quality Criteria
WSC	West Service Center
WTP	Water Treatment Plant
WWP	Water Works Park Treatment Plant

1. Introduction

The Detroit Water and Sewerage Department (DWSD) currently provides treated water to nearly 4,000,000 people across more than 1,000 square miles of Southeast Michigan, pumping more than 230 BG of water each year. DWSD has set as its mission to "exceed our customers' expectations through the innovative treatment and transmission of water and wastewater that promote healthy communities and economic growth, and excel in the management of cost-efficient water resources for the people of Southeast Michigan." This look forward has been guided by a water master plan initially developed in 1959 and updated in 1966. In order to satisfy its mission, DWSD looks to develop another water master plan to guide the development of its water system over the next 50 years. The Comprehensive Water Master Plan (CWMP), DWSD contract number CS-1278, is to be this new plan.

The first stage of the CWMP, Task A, calls for a review of all previous and ongoing studies related to DWSD master planning, DWSD policies, and regulations governing system operation and expansion. This review can be broken into three distinct categories. Task A1 is a review of related studies, which will provide valuable insight and guidance in the efforts toward constructing the CWMP. Task A2 is a broad evaluation of federal, State, and local regulations and their potential impacts on DWSD source water control, treated and distributed water qualities. Specifically, this task will review the Great Lakes Initiatives and the 1996 amendments to the Safe Water Drinking Act with involvement of the International Joint Commission and Michigan Department of Environmental Quality, if necessary. Task A3 is a review of DWSD water policies and wholesale customer contracts. This task will provide insight into the issues and requirements that need to be addressed by the CWMP.

2. DWSD History

An important first step is to understand the DWSD system's development. A historical review of the water system led to the formation of a timeline. This timeline highlights important dates and features throughout this system's history, starting with the original settlers in 1701.

The DWSD system's recent growth has been guided by the master plan formulated in 1959 and updated in 1966. A series of maps of the southeastern Michigan metropolitan area has been included with this history. The six maps, dated June 1967, 1972, 1974, 1980, 1986, and 1995 document the growth of and proposed changes to the DWSD Water Transmission System resulting from the 1959/1966 master plan.

Timeline History of Detroit's Water System

Year	Event
1701	Detroit is founded on the banks of the Detroit River. Water is obtained by dipping pails and casks in the river.[(1)]
1824	Berthelet's Wharf is erected at the foot of Randolph Street, where a pump is installed for free use by villagers. [(1)]
1827	Rufus Wells is granted exclusive rights to supply Detroit with water. A new intake and pump house on Berthelet's Wharf, a reservoir on Randolph Street near Jefferson, and a distribution system of tamarack logs are constructed to serve the city's 1,500 residents for $10 per family per year. [(1)]
1830	A brick reservoir is constructed at Fort Street between Shelby and Wayne Streets). [(2)]
1831	The Hydraulic Company is incorporated and granted a new charter to supply the city with water. The system is extended to meet an ever-increasing population and to render better service. [(1)] A second oak-plank reservoir is constructed at the Fort Street site. [(2)]
1836	Customer dissatisfaction causes the City to purchase the water system from the Hydraulic Company. The population served is 8,000. [(1)]
1839	The Fort Street brick reservoir is taken down because of poor performance. [(2)]
1841	A new plant, called "New Hydraulic Works," is built at the foot of Orleans Street and put in service. [(1) (2)]
1842	The Fort Street reservoir is abandoned. [(2)]
1852	The Common Council places the Department of Water Supply under the management of a separate organization known as the Board of Trustees. [(1)]
1853	The Michigan State Legislature, on application of the Common Council, amends the City Charter and creates a Board of Water Commissioners to replace the Board of Trustees. The new Board begins a new Improvement and Expansion Program. [(1)]
1857-1872	Additions and improvements are made to the existing works, adding 11 MGD to the system capacity (for a total of 12 MGD). The population served grows from 41,057 in 1857 to 92,043 in 1872. [(1)]
1871	Moses W. Field introduces the first drinking water fountains in Detroit. [(3)]

Timeline History of Detroit's Water System

Year	Event
1873	The first sections of the Water Works Park site are purchased. The population served is 100,000. (1)
1879	Water Works Park Station, including a new intake, is put into operation. This adds 2 MGD of capacity (for a total of 14 MGD). The population served by the system reaches 116,340. (1)
1886	Additions are made to Water Works Park Station to increase capacity by 66 MGD to a total of 80 MGD. 135,000 are served by direct pressure for the first time as the reservoir is cut off. (1) The Water Department moves its business offices into the three-story Fireman's Hall. (2)
1889	The first water meters are installed and the population served reaches 203,992. (1)
1900	The City of River Rouge begins service from the system. (4)
1902	The City of Hamtramck begins service from the system(4).
1904	The City of Ecorse begins service from the system. (4)
1905	A new intake crib in the Detroit River is put into operation and additions to Water Works Park Station are completed, adding 72 MGD for a total capacity of 152 MGD. The population served reaches 369,805. (1)
1909	Work is started on Water Works Park Station No. 2 as the population served reaches 440,618.1)
1913	A typhoid fever outbreak in the previous year leads to disinfection of water. The population served reaches 605,000. (1)
1914	Water Works Park Station No. 2 is completed. (1)
1920	The City of Grosse Pointe Park begins service from the system. (4)
1922	The City of Lincoln Park and the City of Ferndale begin service from the system. (4)
1923	The Water Works Park Filtration Plant is put in service. The total population served is 1,371,500 and the system has a rated capacity of 316 MGD, with a maximum of 395 MGD. (1)
1925	The City of Melvindale and the City of Eastpointe begin service from the system. (4)
1927	The City of Grosse Pointe Woods and the City of St. Clair Shores begin service from the system. (4)
1928	The City of Lathrup Village (through the Southeastern Oakland County Water Authority), the City of Roseville, and the City of Taylor begin service from the system. (4) The Water Department moves out of Fireman's Hall into the newly constructed (in only 7 months) 23-story Water Board Building on Randolph. (2)
1929	The City of Allen Park, the City of Dearborn Heights, the Village of Grosse Pointe Shores, the City of Oak Park, the City of Pleasant Ridge (through the Southeastern Oakland County Water Authority), the City of Riverview, and the City of Trenton begin service from the system.4)
1931	The construction of a new Detroit River intake at the head of Belle Isle and of the Springwells Plant adds 272 MGD in rated capacity (for a total of 588 MGD) and 340 MGD in maximum capacity (total of 735 MGD) to serve 1,678,635 people. (1) The City of Dearborn, the City of Inkster, the City of Livonia, and the City of Royal Oak (through the Southeastern Oakland County Water Authority) begin service from the system. (4)
1933	The City of Wayne begins service from the system. (4)
1934	The City of Garden City begins service from the system. (4)

Timeline History of Detroit's Water System

Year	Event
1938	Grosse Ile Township begins service from the system. [4]
1939	The City of Harper Woods and Royal Oak Township begin service from the system. [4]
1940	The City of Farmington Hills, Redford Township, and the City of Warren begin service from the system. [4]
1941	The City of Southfield (through the Southeastern Oakland County Water Authority) begins service from the system. [4]
1942	The City of Huntington Woods (through the Southeastern Oakland County Water Authority) and the City of Southgate begin service from the system. [4]
1943	Brownstown Township, the City of Gibraltar, the City of Romulus, and the City of Woodhaven begin service from the system.4)
1953	The City of Berkley (through the Southeastern Oakland County Water Authority), the City of Westland, and the City of Sterling Heights begin service from the system. [4] Eastside Reservoir (10 MG), Northwest Reservoir (10 MG), Electric Avenue Reservoir No. 1 (3 MG), and Electric Avenue Reservoir No. 2 (3 MG) are constructed. [5]
1954	Michigan Avenue Reservoir No. 1 (3 MG) is constructed. [5]
1955	The City of Clawson begins service from the system. [4] West Chicago Reservoir (10 MG) and Michigan Avenue Reservoir No. 2 (4 MG) are constructed. [5]
1956	Northeast Plant is placed in operation, which adds 192 MGD of rated capacity (total of 780 MGD) and 240 MGD of maximum capacity (for a total of 975 MGD) to serve 3,057,200 people [1] The City of Birmingham (through the Southeastern Oakland County Water Authority) and the City of Hazel Park begin service from the system. [4] St. Clair Shores Reservoir (4 MG) is constructed. [5]
1957	The City of Madison Heights begins service from the system. [4]
1958	The Village of Beverly Hills (through the Southeastern Oakland County Water Authority) begins service from the system. [4]
1959	Springwells Plant receives a $35 million addition to add 160 MGD in rated capacity (940 MGD total) and 200-MGD maximum capacity (total of 1,175 MGD) to service of over 3 million people. [1] Huron Township, Canton Township, and the City of Center Line begin service from the system. [4] The Detroit Department of Water Supply begins utilizing a master plan, entitled "Detroit's Water Development Program for the Metropolitan Area."
1961	The City of Farmington and Plymouth Township begin service from the system. [4] The last coal-powered, steam-fed, high-lift pumps at WWP are electrified. [3]
1962	North Service Center Reservoir No. 1 (10 MG) and Ford Road Reservoir (10 MG) are constructed. [5]
1963	The City of Fraser, the City of Pontiac, the City of Utica, and Van Buren Township begin service from the system. [4]
1964	The City of Troy, Bloomfield Township, the City of Belleville, and Northville Township begin service from the system. [4] The Wayne County Road Commission constructs southwest Plant. Plant operations are subsequently taken over by the Detroit Department of Water Supply through a lease-purchase agreement that includes other components of the Wayne County system. [6]
1965	The City of Auburn Hills and the City of Novi begin service from the system. [4] West Service Center Reservoir No. 1 (10 MG) and North Service Center Reservoir No. 2 (10 MG) are constructed. [5]

Timeline History of Detroit's Water System

Year	Event
1966	The City of Mt. Clemens (no longer served), the City of Northville, and Shelby Township begin service from the system. [4] West Service Center Reservoir No. 2 (10 MG) is constructed. [5] The master plan is updated under "Detroit's Development Program for Southeastern Michigan 1966-2000."
1967	Clinton Township, the City of Keego Harbor, the City of Flint (through the Flint system), Sumpter Township, and the City of Flushing (through the Flint system) begin service from the system. [4]
1968	The Village of South Rockwood begins service from the system. [4] Franklin Reservoir (10 MG) is constructed. [5]
1969	Ash Township, the Village of Carleton (through the Ash Township system), the City of Lapeer (through the Greater Lapeer County Authority), and the City of Clio (through the Flint system) begin service from the system. [4]
1970	West Bloomfield Township, Berlin Township, Estral Beach (served by the Berlin Township system), the City of Bloomfield Hills, Harrison Township, Flint Township (through the Flint system), Flushing Township (through the Flint system), and Mt. Morris Township (through the Flint system) begin service from the system. [4] Schoolcraft Reservoir (10 MG) and Joy Road Reservoir No. 1 (5 MG) are constructed. [5]
1971	The City of Swartz Creek (through the Flint system), Davison Township (through the Flint system), the City of Imlay City (through the Greater Lapeer County Authority), and the City of Plymouth began service from the system. [4] Imlay Reservoir (20 MG) is constructed. [5]
1972	The City of Rochester Hills, Ypsilanti Township (through the Ypsilanti Community Utilities Authority), the City of Mt. Morris (through the Flint system), Mundy Township (through the Flint system), Pittsfield Township (through the Ypsilanti Community Utilities Authority), and Vienna Township (through the Flint system) begin service from the system. [4]
1973	The City of Burton (through the Flint system) and Clayton Township (through the Flint system) begin service from the system. [4]
1974	Chesterfield Township, Gaines Township (through the Flint system), and the Oakland County Drain Commission began service from the system. The Lake Huron Water Treatment Plant is constructed. [4]
1976	The Village of Almont (through the Greater Lapeer County Authority) begins service from the system. [4]
1977	The Wick Reservoir (10 MG) is constructed. [5]
1978	Genesee Township and Montrose Township (through the Flint system), Greenwood Township (through the St. Clair County - Board of Public Works), and Washington Township begin service from the system. [4]
1979	The City of Montrose (through the Flint system) begins service from the system. [4]
1980	Augusta Township (through the Ypsilanti Community Utilities Authority), Orion Township, Superior Township (through the Ypsilanti Community Utilities Authority), York Township (through the Ypsilanti Community Utilities Authority), the Village of Romeo, and Macomb Township begin service from the system. [4]
1981	Village of Bingham Farms (through the Southeastern Oakland County Water Authority) and Mayfield Township (through the Greater Lapeer County Authority) begin service from the system. [4]
	Hazen & Sawyer, Inc submit "Study of Water Works Park Plant and Water Transmission System".

Timeline History of Detroit's Water System

Year	Event
1982	The City of Rockwood and the City of Flat Rock begin service from the system. (4)
1983	Joy Road Reservoir No. 2 (5 MG) is constructed. (5)
1986	Commerce Township begins service from the system. (4)
1989	The City of Walled Lake begins service from the system. (4)
1990	Lenox Township begins service from the system (4) .
1992	The Village of New Haven, the City of Sylvan Lake, and Grand Blanc Township (through the Flint system) begin service from the system. (4)
1993	Orchard Lake Village (through the West Bloomfield Township system) begin service from the system. (4)
1994	The Village of Lake Orion (through the Orion Township system) and City of Ypsilanti (through the Ypsilanti Community Utilities Authority) begin service from the system. (4)
	"Lead and Copper Control Optimization Study",
	"Energy Optimization of Water Distribution Systems",
	"Northern and Western Water Distribution Facility Plan Update—Hydraulic Analysis Interim Report" are submitted by Tucker, Young, Jackson, Tull, Inc.
1995	Richfield Township (through the Flint system) begins service from the system. (4) "Safe Drinking Water Act Response Program",
	" Water Supply Sanitary Survey (DRAFT)", and
	"Interim DRAFT Report Mobile Research Laboratory—Ozonation" are submitted by TYJT.
1996	"INTERIM TECHNICAL MEMORANDUM Water Quality in Booster Station Storage Reservoirs: Preliminary Evaluations and Recommendations" is submitted by TYJT.
1997	"Water Demand Forecasts",
	"Hydraulic Transient Analyses of the Lake Huron Water Transmission System", and "Water Quality Model of the DWSD Transmission System" are submitted by TYJT.
	Sigma Associates, Inc submit "Conceptual Water Master Plan".
1998	Burtchville Township begins service from the system.4)
	"Study Report Wixom Water Supply;" and
	"Draft Study Report Water Main from 31 Mile Road and GTWRR West to South to Walton Blvd. and Giddings Road Including Romeo Station" are written by DWSD.

Notes:

(1) "Detroit's Water Development Program for the Metropolitan Area," 1959.
(2) "The 100th Annual Report of the Department of Water Supply City of Detroit," 1952.
(3) DWSD website, "Water System: A Brief History"
(4) "Summary of Operating Statistics for Fiscal Year Ending June 30, 2000".
(5) "INTERIM TECHNICAL MEMORANDUM Water Quality in Booster Station Storage Reservoirs," 1996.
(6) "Detroit's Water Development Program for Southeastern Michigan, 1966–2000."

3. Review of Previous and Ongoing Studies Related to DWSD Master Planning

3.1 Partnership for Safe Water Self-Assessment Completion Report

3.1.1 Background Information

The Partnership for Safe Water (PSW) was developed and implemented by the American Water Works Association (AWWA) and other professional organizations representing drinking water utilities. The PSW's objective is to equip and encourage water suppliers to "identify areas that will enhance the water system's ability to prevent entry of *Cryptosporidium, Giardia*, and other microbial contaminants into treated water—and to voluntarily implement appropriate corrective actions." The PSW is completely voluntary, and as such reflects a strong commitment by participating utilities to consistently strive for the best possible treatment. The optimization techniques under the PSW focus primarily on removing particles and improving barriers to chlorine-resistant pathogens.

The Detroit Water and Sewerage Department (DWSD) demonstrated its commitment to voluntary water quality optimization by joining the PSW in February 1997. As early as 1994, well before formally joining the PSW, DWSD had begun a process of optimizing particle removal at its surface water treatment plants. By 1995, DWSD has developed a Safe Drinking Water Act (SDWA) Response Program to identify immediate actions critical to improving barriers to *Cryptosporidium* and other chlorine-resistant pathogens. These efforts were valuable and fully consistent with PSW self-assessment goals. After joining the PSW, DWSD began conducting a self-assessment for each of the five water treatment plants. The self-assessment included a performance assessment; a major unit process evaluation; and a design, operational, and administrative assessment. The following sections will summarize the self-assessment results of Lake Huron, Southwest, and Northwest Water Treatment Plants, which were reported in the Self-Assessment Completion Report for Lake Huron Treatment Plant (September 1998), Completion Report for Northeast Treatment Plant (1999), and for Southwest Treatment Plant (May 1998), respectively. The performance-limiting factors as well as short- and long-term corrective actions identified for each treatment plant will also be reviewed there.

3.1.2 DWSD System Overview

DWSD provides potable water to 4,000,000 customers in southeastern Michigan. Its water system consists of five water treatment plants and twenty-one booster pumping stations located throughout the distribution system. The water supply system draws raw water from Lake Huron and the Detroit River through three intakes. The intake on Belle Isle in the upper Detroit River supplies raw water to Water Works Park, Northeast and Springwells Water Treatment Plants. The intake off Fighting Island in the lower Detroit River supplies

Southwest Plant while Lake Huron Plant gets its raw water from an intake in Lake Huron. All five treatment plants provide complete treatment of the raw water through a process that includes coagulation, sedimentation, filtration, and pre- and post- chlorination for disinfection. In addition, DWSD has been fluoridating its water since 1967 and in September 1996 the department started adding phosphoric acid to the finished water for corrosion control. The combined capacity of the five water plants is more than 1 BGD.

3.1.3 Lake Huron Water Treatment Plant

3.1.3.1 Water Treatment Plant Summary

The Lake Huron Treatment Plant was built in 1974 and is the newest of the DWSD's five water treatment plants. Raw water is supplied to the Lake Huron WTP by a 16-foot diameter raw water intake tunnel. The tunnel is 6 miles in length and extends about 5 miles into Lake Huron. Four vertical turbine pumps are used to bring raw water up to the plant operating elevation. After adding the coagulant (liquid aluminum sulfate), the chemically treated water flows from the low lift discharge/rapid mix conduits into two parallel flocculation basins. At the end of each flocculation chamber, water flows through a "false wall" baffle into a rectangular, horizontal-flow sedimentation basin for settling. After leaving there, water travels to the filtration plant, which has 20 dual media gravity filters that can provide a total surface area of 46,400 ft^2. After the addition of post chlorine for disinfection, the filtered water is then pumped out into the distribution system by the high lift pumps or stored temporarily in the two clear water wells. The design 24-hour treatment capacity of this plant is 400 MGD.

3.1.3.2 Plant Performance Limitations, Recommendations and Actions

Based on the Partnership assessment, performance-limiting factors for Lake Huron Treatment Plant were identified and the corresponding short- and long-term corrective actions were suggested to DWSD. Some limitations were immediately acted upon while others were awaiting authorization. As of September 1998, several key rehabilitation and water quality improvement projects had been completed or were underway at that time. These improvements included installation of a variable-speed drive on Low Lift Pump No. 1 to avoid rapid and large variations in raw water flow and associated filtration rates; enhancement of the primary coagulant application points and installation of new mechanical rapid mix equipment; replacement of inoperable flocculation equipment; rehabilitation/expansion of existing chlorine disinfection facilities; installation of more online turbidity and particle counting monitors for a better control of finished water quality; installation and assessment of utilizing streaming current detectors (SCDs) for coagulant monitoring/control; and implementation of a proactive and aggressive primary coagulant control strategy to improve responses to raw-water quality changes. Improvements of onsite residuals handling and dewatering were addressed in the current 5-year CIP, and elimination of the practice of recycling backwash wastewater was expected by 2002.

The short-term issues addressed were huge incremental shifts in raw water flow rate, utilization of other raw water quality indicators than turbidity alone, replacement of rapid mixing and flocculation equipment, and the introduction of chlorine-resistant pathogens to the treatment stream due to recycling of the backwash wastewater. Improvement on the coagulant dosage selection was needed. It was suggested that a more quantitative and consistent coagulant dosage response plan for raw water quality changes should be developed by exploring integration of all available tools (turbidity, particle size distributions, SCD readings, pilot plant data, etc.) for Lake Huron Plant.

The long-term corrective actions included enhancing the communications between treatment plant staff; monitoring the filter media condition and primary disinfection effectiveness; improving the coagulant feed flexibility by applying low molecular weight synthetic organic polyelectrolytes to raw or settled water; and improving sedimentation basin capacity limitations and performance problems.

3.1.4 Southwest Water Treatment Plant

3.1.4.1 Water Treatment Plant Summary

The Southwest Water Treatment Plant was originally built by Wayne County and then purchased by DWSD in 1964. Raw water comes into the plant from the intake on the Canadian side of the Detroit River off Fighting Island. It travels through a 12-foot diameter tunnel to the low-lift caisson where it is lifted to an elevation that allows water flow through the rest of the plant by gravity. From the low lift, the water travels to the rapid mix area where alum, chlorine, carbon, and fluoride are added. After coagulation takes place, flocculation occurs in the flocculation chambers where the new walking-beam flocculators were installed in 1998. The following settling process takes place in the four sedimentation basins with a combined capacity of 28 MG. The water then travels to the filtration plant, which has 20 double-unit declining rate filters. After the addition of post-chlorine and phosphoric acid, the filtered water is collected in four equalization chambers and then pumped out into the distribution system by the high lift pumps or stored temporarily in three above ground reservoirs, each with a capacity of 10 MG. The average output rate for the Southwest Water Plant is about 80 MGD.

3.1.4.2 Plant Performance Limitations, Recommendations and Actions

Based on the Partnership assessment, performance-limiting factors for Southwest Treatment Plant were identified and the corresponding short- and long-term corrective actions were recommended on coagulation, rapid mix, flocculation, sedimentation, filtration, process testing, and staff administration. Some limitations were immediately acted upon. As of May 1998, the improvement projects already undertaken included: scheduled maintenance and calibration to help in the avoidance of alum-feed interruption incidents; an audible alarm installed to give a quick warning of the complete failure of the coagulant feed line; and "working Beam type" flocculators installed to replace the old inoperable flocculators. To solve the insufficient media expansion problem during backwashing filters, the backwash flow rate was adjusted higher for the high wash cycle.

The short-term issues addressed were: establishing a routine preventive maintenance program to ensure proper functioning of flocculators; fixing the leaking surface wash-water lines so that the filters get a quality surface wash; periodically cleaning the filters and sweep nozzles; monitoring flow rate on each filter in the north gallery; fixing some filter water pumps; and scheduling regular inspections of filter sampling tubes to ensure that the sample is flowing through a calibrated turbidimeter. The recommended short-term actions regarding process testing included the implementation of a routine checking and calibrating program to ensure the proper functioning of turbidimeters and alum rotodip feed system. In order to optimize feed dose by avoiding overdosing alum, implementation of a coagulant control program was suggested.

The long-term corrective actions included repairing raw water screens to prevent debris from entering the treatment system; evaluating the possibility of installing plate settlers for the sedimentation basin; installing more air release valves along the backwash piping to avoid supporting gravel mounding and media loss during the backwashes; and repairing/ replacing the roof over the filters. As to the staff administration, suggested the long-term actions were providing continuous in-house training to improve the skills of all treatment plant operators, and organizing seminars to keep operators abreast of the existing and impending regulations.

3.1.5 Northeast Water Treatment Plant

3.1.5.1 Water Treatment Plant Summary

The Northeast Water Treatment Plant was built in 1956 to serve the growing needs of the City's northeastern suburbs. Raw water from the intake on Belle Isle travels through a 14-foot diameter common tunnel which branches into two tunnels: a 12-foot diameter tunnel to Springwells Water Treatment Plant and a 10-foot diameter tunnel to Northeast Water Treatment Plant. The raw water enters the low lift caisson, which is about 90 feet below ground level, where it is lifted to plant level and then flows through the rest of the plant by gravity. After the second dose of pre-chlorine, the raw water enters the rapid mix in the Chemical Building where alum is added. Activated carbon is also added at this point whenever there is a taste and odor problem. After coagulation and flocculation occur, the following sedimentation takes place in the four settling basins, each with a capacity of 8 MG. The settled water from the basins then flows to the filter plant, which has 48 variable rate, rapid sand filters with a capacity up to 8 MGD each. After the addition of post-chlorine and phosphoric acid for corrosion control, the filtered water is pumped out into the distribution system or stored in two 15 million-gallon underground reservoirs. An additional 8-MG storage is available in the underfilter storage. The average daily output for Northeast Water Plant is about 120 MGD.

3.1.5.2 Plant Performance Limitations, Recommendations and Actions

Based on the Partnership assessment, performance-limiting factors for Northwest Water Treatment Plant were identified and the corresponding short-term and long-term corrective actions were recommended for coagulation, rapid mix, flocculation, sedimentation, filtration, process testing, and staff administration. Some limitations were immediately acted upon and most were finished by 1998. The improvement projects finished included scheduling, maintenance, and cleaning work on all rotameters and lines; keeping the constant level box functioning to solve the inadequacy of the coagulant feed system for meeting the water demand during the high turbidity and high-flow-rate periods; installing an alarm system on the constant level box and streaming current monitor in the mixing chamber to allow immediately actions in case of any problems occur; implementing a preventative maintenance program for key treatment equipment; and conducting various experiments on utilizing new coagulants to obtain a better coagulation.

The short-term issues addressed were calibrating alum feed rotameters regularly; repairing the broken rapid mixers, which cause high turbidity for some part of the treatment plant;

installing an online turbidimeter on each individual filter; fixing the malfunctioning rate control valves and head gauges; performing a tracer study to determine the detention time in the reservoir; and implementing a routine maintenance program for all valves and piping associated with the chlorine feed.

The long-term actions were replacing the entire coagulant feed line from day-tank lines to the diffusers; considering switching to "rotodip" alum feed; installing an alarm system on the constant level box to warn of the disruption of the alum feed; and developing a preventative maintenance program for the key treatment equipment. To address the issue of insufficient capacity of the sedimentation basins, evaluating the possibility of either using more sedimentation basins or changing to retrofitting Lamella Plates was suggested. The long-term actions recommended for filtration were making use of the filters that were not currently in service to add to filter capacity and filtration efficiency and changing filter media as well as renovating the filters, etc. As to the disinfection, implementation of a routine maintenance program for all valves and piping associated with the chlorine feed is necessary, as well as the installation of an audible alarm system for warning of low-effluent chlorine residual levels. A lot of long-term actions for Northeast Water Treatment Plant went to the administrative policies such as enhancing operator training, increasing operator exposures to seminars on the regulations, and organizing routine staff meetings.

3.1.6 Importance for CWMP

The assessment results for the Lake Huron, Southwest, and Northeast Water Treatment Plants can be used as a reference for developing requirements for treatment plant process improvements within the current plant configuration and over the planning years as listed in Task D—Water Quality Management Plan.

3.2 Study Report: Wixom Water Supply

3.2.1 Background Information

The Planning Section of the Engineering Division of DWSD wrote this report in January 1998. The purpose of the study was to investigate the most efficient and economical method of providing a maximum daily flow of 5.3 MGD to the City of Wixom. Population demands were based on SEMCOG projections for 2000, 2005, 2010, and 2020. Demand projections used per capita demands based on the previous year's consumption data for communities currently served by DWSD in the area. The Wixom demand data were obtained from comparisons to similar communities in the DWSD service area.

3.2.2 Transmission System Summary

The Lake Huron WTP serves the DWSD water system in the Wixom area. Water travels via the 72-inch main to the Franklin Pump Station (FPS), where some of the water is repumped north to the Adams Road Booster Station service area and the remainder is sent west in the 54-inch main down 14 Mile Road. This main reduces to 48-inch from Farmington Road to Haggerty Road, where it becomes a 42-inch main dead-ending at Decker Road. Service connections off the 14 Mile Road main include the City of Farmington Hills, West Bloomfield Township, the City of Novi, Commerce Township, and the City of Walled Lake. To provide service to the City of Wixom, the 42-inch pipeline needs to be extended at least to Beck Road, the eastern boundary of Wixom. This main would dead end at this point, leading to a need for reservoir storage. The reservoir would promote flow upstream of the reservoir by eliminating the dead end. A DWSD plan for a 96-inch main, called the North Metro Loop, is also expected to improve service to this area by 2010.

The report investigated four alternatives for service to the City of Wixom. These alternatives included various locations for a storage tank, referred to as a high-ground reservoir, which would have a capacity of 10 MG. Other features include transmission mains that would connect to the North Metro Loop and booster stations. For hydraulic analyses, a maximum hour demand of 127 MGD was used for the 14 Mile Road communities.

Cost estimates for the four alternatives were computed using an expected life of 30 years, excluding any main that will become part of the North Metro Loop and including any upgrades to the FPS determined to be necessary for this project.

Alternative 1 had the lowest construction costs, at $33 million. However, it was excluded from consideration because it was considered to not be hydraulically feasible once the North Metro Loop was in operation by 2010. Costs for the other alternatives were as follows:

Alternative	Construction Costs	O&M	Total Costs
2	$47,000,000	$15,624,216	$63,000,000
3	$38,000,000	$16,006,824	$54,000,000
4	$36,000,000	$15,480,462	$51,000,000

3.2.3 Recommendations

The hydraulic analyses and cost estimates performed for this report led to the recommendation of Alternative 4. This alternative included extending the 42-inch main on 14 Mile Road west to Maple and Wixom Roads. This main would turn north on Wixom Road as a 96-inch main (part of the North Metro Loop) and run to Charms Road, where it would turn west and travel to Buno Road. At Buno Road a 36-inch main would travel west and run from Charms Road to Child Lake Road, where it would turn north and runs to a 10 million-gallon reservoir. A booster station would be built at 14 Mile Road east of Haggerty Road (Haggerty Station) to fill the reservoir. Hydraulic analyses project that the lowest pressure in the 14 Mile Road corridor in 2010 will be 73 psi at the Commerce Township Meter, CM-1. This alternative would satisfy the pressure needs of all the communities along 14 Mile Road west of FPS.

3.2.4 Importance for CWMP

Current plans at DWSD are to locate the reservoir on the same site as the Haggerty Road Booster Station. The reservoir would not be elevated storage. The plans outlined in the report will be updated based on the most current information. The most current plans will then be evaluated and incorporated in future analyses as outlined in Task C and Task D. As of March 2000, a service contract with Wixom has been signed, design of pipeline in 14 Mile Road is underway by the DWSD Pipeline Section. The Planning Section is developing a

Haggerty Road P.S. Basic Requirement Report. The high ground land in Proud Lake Recreation area was not available to DWSD.

3.3 Draft Study Report Water Main from 31 Mile Road and GTWRR West to South to Walton Blvd. and Giddings Road Including Romeo Station

3.3.1 Background Information

The DWSD wrote this report in January 1998. Oxford Township has contaminated wells in their water system. DWSD proposes to serve Oxford Township through a 96-inch main (part of the Metro Loop). The purpose of this study was to investigate the route, hydraulics, and estimated cost to serve Oxford. The route was originally recommended in the Flint Loop Draft Study Report dated February 1993.

3.3.2 Transmission System Summary

This report identified system operation needs to serve Oxford. They include a water main and pumping station (Romeo Station). Sizing of the facilities were based on providing maximum hour service for 2005, 2010, 2020, and 2025. The water demand for the pumping station and pipeline included existing and potential customers of DWSD using 2025 demands. The governing criterion for the size of the pipeline was related to its eventual use as part of the Metro Loop to Flint. The proposed route and station construction was broken into two stages.

Stage I involved the construction of Romeo Station at 31 Mile Road, where the proposed 96-inch main would connect to the existing 96-inch main. Romeo Station would be required to boost water to the west because of high ground elevations. The new 96-inch main was proposed to run west along 31 Mile Road and Clarkston Road to M-24 (Lapeer Road). The total cost of this stage was estimated to be $67 million.

Stage II, to be completed by 2010, involved continuing this main west to Baldwin Road, where a tee and gate valve would be provided for a second Flint connection. The 96-inch would then turn south down Baldwin Road to Maybee Road, where it would connect to the rest of the Metro Loop from Wixom by 2020. A 48-inch main would continue south on Baldwin Road and work it’s way to Giddings Road, where a connection would be made to the existing 42-inch main in Walton Boulevard. This stage was expected to cost $40,000,000.

3.3.3 Recommendations

This report provided the population and water demand estimates for the communities along the proposed route. Expected suction and discharge pressures from the proposed Romeo Station for 2005, 2010, 2020, and 2025 were also provided. The completion of the entire Metro Loop is expected by 2025.

3.3.4 Importance for CWMP

The information from this report is to be used as part of DWSD’s Comprehensive Water Master Plan for Task C and Task D. Finalization of the route is still ongoing with the DWSD and the local communities. The final route identified by the DWSD will be evaluated and incorporated into this project for future hydraulic and water quality analyses.

3.4 Conceptual Water System Master Plan

3.4.1 Background Information

This Conceptual Water Master Plan (CWSMP) report presents the Phase I study of a two-phase process for developing a comprehensive Master Plan for the DWSD water system. It was developed by Sigma Associates, Inc. in conjunction with Metcalf & Eddy in August 1997. The main goals of the Phase I study were to investigate the implementation of a new concept to convert the existing mode of operation (series pumping) into a high ground storage system with pressure zones to decrease energy use; to minimize peak demands imposed on water treatment plants, pumping stations, and transmission mains; and to simplify the system operation. The high-ground storage concept would utilize the reservoirs located on ground high enough to allow gravity feed to each pressure zone. It was believed that this concept would offer many benefits, including reducing pumping costs by eliminating dump and repump operations at the existing ground storage reservoirs, eliminating throttling of booster pumps to meet pressure or water demand conditions, simplifying the operation of the system, and increasing system reliability to meet emergency demands. Other purposes of this study were to summarize the background data, identify deficiencies in data that should be improved for the Phase II study and provide some short-term recommendations regarding several developing areas for DWSD. In addition, this study evaluated the Water Works Park Alternatives and recommended that there should continue to be treatment capacity at the WWP site, meanwhile the rehabilitation program at WWP should be discontinued in favor of a new plant.

3.4.2 Water Demand and Population

The planning area and population projections for this study were provided by DWSD's Office of Program Management Assistance (OPMA). Two scenarios of future growth were developed to estimate the population served through 2050, and Scenario 2 was adopted as the basis of population projections used in the CWSMP. Scenario 2 was based on Scenario 1 but added the projected population density. According to the population projection, the population in the communities served by DWSD was projected to increase from 3.9 million in 1990 to 4.9 million by 2050. The population of new customers to be served by DWSD was projected to be about 600,000 by 2050, making the total population served approximately 5.5 million.

The average day water production was 640.6 MGD, and unaccounted-for water was about 14 percent. The projections for population served and the annual average per-capita demand data were combined to develop projected future annual average water-demand scenarios. The projected annual average day water demands for 2050 ranged between 942 MGD and 1,007 MGD. The maximum day peaking factors were then applied to the annual average demands to develop projections of future maximum day demands.

Based on the DWSD's historical data, the maximum day peaking factor of 2.13 was selected as a basis for future planning of this CWSMP. Three scenarios were developed to estimate the future maximum day water demands. Scenario 2, which utilized an individual peaking factor for each customer community and was also combined with Population Growth Scenario 2, was selected in this study. A value of 12 percent was used for the estimated unaccounted-for water amount for the next 50 years. Table 3-1 summarizes the 1990 existing water demand and projected water demands for Scenario 2 in this study.

TABLE 3-1
Existing (1990) and Projected Water Demand for Scenario 2 in CWSMP

Customers	Annual Average Demands (MGD)			Maximum Day Demands (MGD)		
	1990	2020	2050	1990	2020	2050
Existing	662	721	763	1,413	1,624	1,775
New	_	50	78	_	116	197
Existing + New	662	771	841	1,413	1,740	1,972
UFW	79	93	101	79	93	101
Total	741	864	942	1,493	1,833	2,073

3.4.3 DWSD Water System

DWSD supplies the treated water on a retail basis to Detroit and Dearborn, and on a wholesale basis to more than 100 suburban communities. Water is supplied to the transmission and distribution system by direct pumping. There are no online storage reservoirs to meet the peak hour water demands. Twenty water booster-pumping stations located throughout the transmission system boost the water pressure supplied to customers.

3.4.3.1 Operation of Transmission and Distribution System

The water transmission system is operated to maintain pressures within a certain range at a number of locations in the system, including the discharge side of the 20 water booster stations, the 5 high lift pumping stations, and approximately 30 other pressure-monitoring points. The monitored pressure is telemetered to the System Control Center (SCC), which is located in the second floor of the Water Board Building. System pressure is maintained by controlling the operation of pumps, pump discharge valves, and reservoir fill valves. Operators at the SCC manually control the whole water transmission system, although most of the individual booster pumping stations are automatically controlled. Many booster-pumping stations supply other pumping stations in series farther out in the system, which compounds the complexity of controlling the system.

During peak demand periods, operators at the SCC report difficulty in conveying water across the transmission system to refill ground storage reservoirs at some locations and in maintaining adequate pressure in portions of the system. DWSD initiated some corrective actions to address the low-pressure problems in Rochester, Shelby Township, and Novi. These actions included expanding Lake Huron Water Treatment Plant capacity, putting Imlay Station in service, expanding the North Service Center and Adams Road booster stations, and constructing a new Rochester booster station. Also a new 72-inch transmission main was placed in service between North Service Center and Franklin Station. However, no plans were identified to solve the low-pressure problems at West Service Center (WSC) during the peak demand.

3.4.3.2 Operation of Water Treatment Plants

Water Treatment Plant operators are responsible for monitoring and maintaining full water levels in the treated water storage reservoirs or clearwells at each plant by increasing or decreasing the plant production. SCC controls the high-lift pumping stations at the treatment plants to supply the water to the transmission system. The present operation mode of the transmission system results in frequent changes in production at some water treatment plants to meet peak demands.

3.4.4 System Operation Concepts and Planning Model Development

In this conceptual water master planning study, six separate zones were developed with about 110 feet of vertical distance between zones. Multiple high-ground storage reservoirs were placed in each pressure zone and each reservoir was located as near as possible to the existing transmission mains at high ground elevations. Two schemes were developed to analyze the alternative local system improvements for water supply to Wixom.

EPANET software developed by USEPA was adopted for analyzing the transmission system hydraulics. Two versions of this model were used for this study, base 1993 maximum day model and planning model of 2050.

3.4.5 Study Recommendations

Recommendations were made relating to rechecking population projections, reevaluating the peaking factor, reviewing the calibration of the analysis model, as well as flow and pressure monitoring.

3.4.6 Importance for CWMP

This Conceptual Water System Master Plan serves as the basis of various tasks. The developed system operation concept of utilizing multiple high-ground storage areas will be reviewed and incorporated into the Comprehensive Water Master Plan. The EPANET planning model used in this study will be updated and forms the basis for analyzing the various operating scenarios of pumping, storage, and transmission in the CWMP for fulfilling Task C1 (Hydraulic Models) and Task C2 (Pumping and Storage Plan). In addition, the summarized background data will be very helpful in identifying any additional information needed for this CWMP.

3.5 Hydraulic Transient Analyses of the Lake Huron Water Transmission System

3.5.1 Background Information

Tucker, Young, Jackson, Tull, Inc. (TYJT) wrote this report in May 1997, in association with Metcalf and Eddy, Inc. A pump trip (sudden loss of power to an operating pump) can cause a sudden loss of pressure in the line, which can cause the formation of vapor cavities in high points in the line. The subsequent collapse of these pockets can cause dangerously high-pressure spikes in the system. This project's purpose was to quantify the magnitude of transient pressures (or surges) in the Lake Huron WTP transmission system. The hydraulic analysis was performed using KYSURGE and WHAM computer models. A 1988 study by Harza Engineering attempted a similar analysis of transients, but used a computer program that could not accurately predict vapor cavity formation.

3.5.2 Transmission System Summary

The DWSD water system supplied by the Lake Huron WTP consists of three major transmission lines. There are 27 miles of 120-inch concrete pipe from the Lake Huron WTP to the Imlay Station, 32 miles of 72-inch concrete main from Imlay Station to Flint, and 35 miles of 96-inch concrete main from Imlay Station to the North Service Center. The 120-inch line has three dual 12-inch air release/vacuum relief valves (AVV's) along its length for control of transient events. The design pressures for this pipe are 225 psi near Lake Huron, 175 psi near Imlay, and 200 psi for all points in between. The maximum flow from the plant was determined to be 400 MGD using all seven pumps.

The 96-inch main uses seven 8-inch AVV's. This main was designed for 200 psi at Imlay and the NSC, with 175 psi in between the two stations. Five Imlay pumps pumping 300 MGD to NSC was used as the maximum flow condition for this analysis.

The 72-inch main was designed with 14 8-inch AVV's to control hydraulic transient events. This pipeline was designed for 200 psi from the station to approximately 17,000 feet west of the station, with the remainder at 150 to 175 psi. The maximum flow rate analyzed for this line was 120 MGD.

Pump discharge lines from both Imlay Station and the Lake Huron WTP use 42-inch cone valves designed to close 15 to 30 seconds after a pump trip. Also, each individual pump discharge line has an 8-inch quick acting AVV.

The hydraulic transient analyses assumed that the existing AVV's on the pipelines were not functioning. This assumption was considered valid during the winter months due to freezing temperatures.

3.5.3 Recommendations

Analysis of the 96-inch and 72-inch mains indicated that transient pressures are within acceptable limits of the pipes. However, unacceptable surge conditions did exist for the 120-inch main. Four alternatives capable of preventing damaging surges were recommended. These recommendations were:

1. Three one-way surge tanks
2. A check valve assembly downstream of the Lake Huron WTP
3. A one-way surge tank at the Lake Huron WTP
4. Vacuum-breaking valves located along the 120-inch main

As part of DWS-812, Imlay Station Improvements, Option 4 was incorporated into the contract. The work consisted of heat-tracing the AVV piping and providing sump pumps in the valve vaults. This design provides continuous operation throughout the year, including in cold weather.

3.5.4 Importance for CWMP

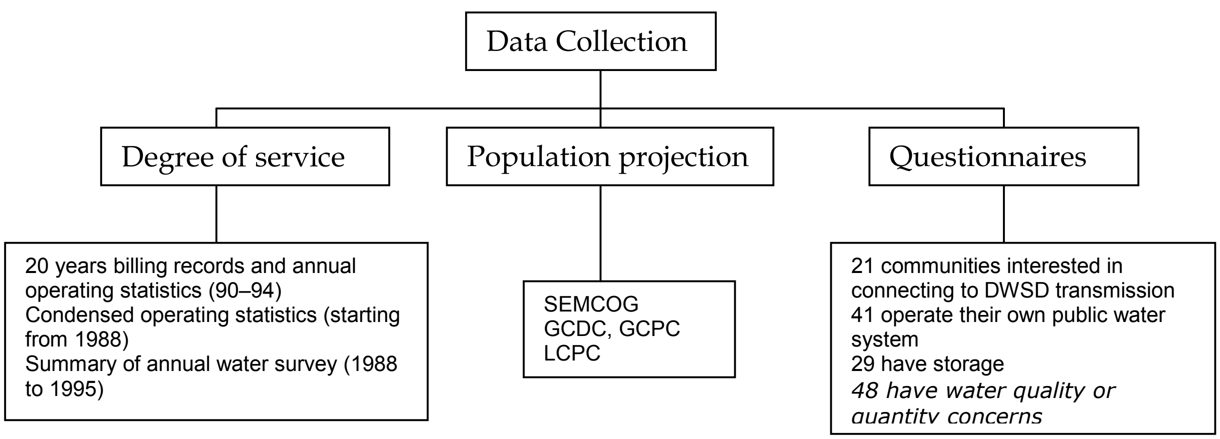
The transient information will be evaluated and used where appropriate.

3.6 Water Demand Forecasts Report

3.6.1 Background Information

This report was written in April 1997 by TYJT in association with Economic and Engineering Services, Inc., and CH2M HILL, Inc. It presents a comprehensive water demand forecast for DWSD through 2050. Based on the existing per capita demands calculated and the projected service population, the average day water demands of low-, moderate-, and high-growth scenarios for each planning year were predicted. Low-, Moderate- and High-Growth Scenarios were divided to predict future DWSD customer communities. The intermediate planning years were 2000, 2005, 2010, and 2020. In this study, a future DWSD service area of approximately 245 communities was defined. Water demand forecasts were made by considering both the increased service to the existing customers and the connection of new customer communities. For each community, the hourly demand factors, maximum day and maximum hour demands, and unaccounted-for water were also identified for the use in future modeling projects.

3.6.2 Data Collection



Various information was collected regarding the degree of service, projected population, and questionnaires as summarized in the above figure. In order to identify the degree of service to each of the existing DWSD customer communities, information on billing records as well as “Annual Operating Statistics” reports were collected from DWSD. Additionally, “Condensed Operating Statistics” reports were provided by the Suburban Engineering Department, starting with fiscal year 1988. The Annual Operating Statistics reports include information on the population served by its suburban customers, number of service connections, and a contact person for each community. Suburban Engineering also provided the annual water summary for 1988 to 1995.

Population projections for the communities within the defined DWSD service area were collected from three different planning groups, Southeast Michigan Council of Governments

(SEMCOG), Genesee County Drain Commission (GCDC), and the Lapeer County Planning Commission (LCPC). These groups also supplied other important information that was used in forecasting the water demand. SEMCOG provided population projections and land use information for seven of nine counties in the defined service area. Population projections and average daily demand (ADD) for Genesee County and Lapeer County were provided by GCDC, Genesee County Planning Commission (GCPC), and the LCPC, respectively.

A water questionnaire requesting information on the water source plans; capital improvement program; current service population; water quality/quantity concerns; master plan information; storage facilities; water demands and peak-period demand etc. was sent to each of the 245 communities within the service area. In order to estimate the future water usage, information on zoning maps, water usage projections, large water user, and peak-hour demand for each community was also requested.

3.6.3 Future Customer Communities

Three growth scenarios, namely Low Growth, Moderate Growth and High Growth scenarios were defined to predict future customer communities and were used to compute water demand projection for each of the planning years. The Low Growth Scenario assumed that the service area would not expand beyond the communities that were served by DWSD at that time, as well as those identified by the DWSD for service by 2000. The Moderate Growth Scenario was comprised of all the existing communities and those potential customers that did not have a distribution system but had a high probability of connecting to the DWSD transmission system by a given year. High probability of connection was defined as those communities that meet three or more of these criteria below:

- Located within 12 miles (two townships) for an existing or proposed transmission main
- Indicated an interest in receiving DWSD water
- Adjacent to a DWSD customer community
- Average population density (APD) at the time of service equal to, or greater than 1.60 people per acre.
- Identified water quality/quantity concerns.

In addition to counting those communities identified for service in the Moderate Growth Scenario, the High Growth Scenario also included the communities that meet the main access and APD criteria for future service and had a public water system (PWS).

3.6.4 Existing Water Demands

Before water demands were projected for the future planning years, per capita demands for every community with an existing water distribution system were computed by a model developed for this project. 1990 was chosen as the Base Planning Year, as it was the most recent one with census data available.

For those communities that were on private well systems, per capita water demands were calculated based on the known per capita demands and associated land usage.

After the per capita demands were computed, a spreadsheet on existing conditions in 1990 was developed for the use as Base Planning Year. SEMCOG provided the population projections for a majority of the communities within the service area. These projections were provided by Traffic Analysis Zone (TAZ) and summed by each community for the existing conditions. The total ADD for the DWSD system was computed.

3.6.5 Future Water Service Demands

The communities projected for future service by DWSD were divided into five classes (Type A through E) in order to identify the changes in service population for both existing and new customers.

Type A:	DWSD customers 90 percent–100 percent served
Type B:	DWSD customers less than 90 percent served
Type C:	Communities 90 percent–100 percent served by another PWS
Type D:	Communities less than 90 percent served by another PWS
Type E:	Comminutes served by private wells

3.6.6 Water Demand Projections

Based on the calculated per capita demands and the projected service population, the average day water demands for each planning year and each growth scenario through 2050 were computed and summarized in Table 3-2.

In addition to the projected average demands for the planning years, maximum day and maximum hour demands were also identified. These demands were based on the system-record day demand that occurred in July 1988.

Approximately of 12 percent of the total system demand was used to estimate the accounted-for water shown in Table 3-1.

As shown in Table 3-1, between 1990 and 2050, it was projected that the increase in population served will be 32 percent and 54 percent respectively for low and high growth scenarios. The average day demand for 1990 was 640 MGD and this number was expected to increase to 753 MGD for the Low Growth Scenario and to 889 MGD for the High Growth Scenario by 2050.

3.6.7 Demand Forecast Computer Program

The Water Demand Forecast spreadsheets were created as a “living document” that allow update of the forecasts when new information becomes available.

3.6.8 Study Recommendations

It was recommended that the planning year spreadsheet and “Existing Customer” spreadsheets be updated when new information is available. In order to reduce the discrepancies between the billing records, establishing a computer network between the Commercial Division Meter Reading/Suburban Billing Office and Commercial Division Internal Audit Office was suggested.

3.6.9 Importance for CWMP

This report will be used extensively for the CWMP. The demand projections in the study will be reviewed and updated as outlined in the CS-1278 Scope of Work. The updated demands will then be used in modeling the water system for the planning years defined between 2000 and 2050.

TABLE 3-2
Summary of the Projected Service Population and Average Daily Demand

Projected Population Served						
Year	Low Growth		Moderate Growth		High Growth	
	Pop. Served	% increase from 1990	Pop. Served	% increase from 1990	Pop. Served	% increase from 1990
1990	3,720,463	---	3,720,463	---	3,720,463	---
2000	4,008,168	8%	4,008,168	8%	4,008,168	8%
2005	4,117,699	11%	4,129,181	11%	4,559,361	23%
2010	4,236,701	14%	4,287,907	15%	4,778,335	28%
2020	4,454,820	20%	4,488,447	21%	5,089,560	37%
2050	4,907,682	32%	4,977,898	34%	5,745,621	54%
Projected Average Daily Demand						
Year	Low Growth		Moderate Growth		High Growth	
	ADD (MGD)	% increase from 1990	ADD (MGD)	% increase from 1990	ADD (MGD)	% increase from 1990
1990	614	---	614	---	614	---
2000	644	5%	644	5%	644	5%
2005	657	7%	658	7%	727	18%
2010	675	10%	681	11%	758	23%
2020	697	13%	706	15%	801	30%
2050	753	23%	774	26%	889	45%

3.7 Water Quality Model of the DWSD Transmission System

3.7.1 Background Information

This report was written by Tucker, Young, Jackson, Tull, Inc., in association with CH2M HILL, Inc., and was submitted in April 1997. The model was developed for the DWSD to analyze their water transmission system with respect to water quality parameters (chlorine residual and water age.

3.7.2 Water System Summary

The DWSD water system supplies treated water to most communities in Southeastern Michigan. The 4 million people served (nearly half the population of the State of Michigan) reside in a large geographic area. The system has three water intakes providing raw water to five water treatment plants, which use conventional treatment processes (coagulation, sedimentation, flocculation, filtration, and disinfection) and deliver water to the system through high-lift pumps. Booster pumping stations maintain pressures and flow rates throughout the 3,400 miles of pipeline (ranging in diameter from 4 to 120 inches).

To develop a water quality model for the system, it was necessary to collect both hydraulic and water quality data from the system. This study selected 30 sampling sites, including water treatment plants, booster stations, master meters, and customer taps. The measured and recorded water quality parameters included chlorine residual, fluoride concentration (in the Water Works Park service area only), temperature, and pH. Hydraulic data came from two sources. The first source was system data telemetered to the System Control Center (SCC). This data indicated pressures, reservoir water levels, and the status of pumps and valves. A second source was a field-monitoring program that attempted to provide flow and pressure data in key system areas.

A hydraulic model is the basis for a water quality model. Since water parameters can vary over time, an extended period simulation (EPS), or dynamic, model was used to simulate variations in demand and changes in operational conditions at specified time steps. The EPS model used three demand conditions, maximum day, average day, and minimum day. Historical data was used for all three, with additional field data used for the average day conditions.

EPS models require water consumption data as inputs for the designated time steps (hourly for the DWSD models). At the time of this study, most master meters for the wholesale communities only had totalizers to read overall consumption. However, roughly one-third of the master meters did have chart recorders that could be used to measure hourly consumption. To develop the diurnal variations required for the EPS model, the Community Group Demand Factor Approach was used to estimate hourly flow variations in the totalizer-only meters based on the recorded flow rates through the chart recorders. This approach grouped together communities by proximity to each other and similarity in water use.

The cities of Detroit and of Dearborn do not have master meters to record water consumption within each city. Therefore, the two were grouped together and given identical demand patterns. To estimate hourly demand factors, a system mass balance was used to calculate hourly demand for the three different pressure zones in the system.

The calibration of the three models included attempting to match pressures at more than 60 locations. A site was considered calibrated if its absolute mean error (AME) was within five psi. For the maximum day model, 80 percent of the sites fell within the five-psi AME, nearly 95 percent were calibrated for the average day model, and more than 85 percent were calibrated for the minimum day model.

Water quality was evaluated in two areas. The first used the model to represent typical system operations in summer, winter, and spring/fall conditions, simulating both water age and chlorine residual in the system. The second evaluated the effects of operations on water quality separately within the reservoirs. This modeled the reservoirs as completely stirred tank reactors (CSTR) to simulate both water age and chlorine residual.

Current drinking water regulations require a detectable chlorine residual at the customer tap. However, the DWSD water quality model does not include its wholesale customer's distribution piping. Furthermore, the City of Detroit is skeletonized, only including the larger transmission lines. Therefore, the minimum acceptable concentration of chlorine residual was set at 0.5 mg/L at the nodes. A maximum water age of 5 days was also used as the water-age criterion, as it represented the approximate time this loss in chlorine residual would occur.

The water-age analyses yielded good results. The water was less than 5 days in the majority of the system for the varying demand conditions. Most problem areas were at the booster station reservoirs or directly related to reservoir pump operation (i.e., insufficient reservoir turnover).

The chlorine residual analyses of the system also showed good results. The chlorine residual was greater than 0.5 mg/L throughout most of the system. However, several potential problem areas were identified. The booster station reservoirs and downstream areas indicated lower residuals whenever the reservoir pumps were operated during the simulation. Older pipes, and associated higher decay coefficients, led to problems at the boundaries of the Water Works Park (WWP) service area. Low flow rates near some of the master meters led to low chlorine residuals in these areas.

The CSTR water quality analyses were used for calculating water age and chlorine residual within the reservoirs. Water age was determined to be influenced by the age of the inflow water to the reservoir and by the operation (turnover, frequency of use) of the reservoir. Chlorine residual within a reservoir was also influenced by operating conditions.

3.7.3 Recommendations

The report included several recommendations regarding different parts of the study. General recommendations included establishing better water-quality evaluation criteria for the master meters and reservoirs, investigating those areas where the hydraulic model had calibration problems, and improving and expanding data collection and accuracy. Reservoir improvement recommendations included establishing and using a turnover/operation scheme and possible remote monitoring of water quality criteria. Transmission system improvements included investigating varying use patterns through master meters in low-flow areas, establishing a more detailed model of the Detroit portion of the system, investigating the possibility of increased effluent chlorine concentrations at the plants, investigating the feasibility of looping dead-end or low-flow mains, and investigating the feasibility of offsite (not at treatment plants) chlorination facilities.

3.7.4 Importance for CWMP

This report will be used extensively for the CWMP. The models used will be the basis for the modeling done for the master plan. Calibration problems with the hydraulic model will be addressed. Suggested capital and operational improvements will be evaluated as well.

3.8 Interim Technical Memorandum Water Quality in Booster Station Storage Reservoirs: Preliminary Evaluations and Recommendations

3.8.1 Background Information

Tucker, Young, Jackson, and Tull, Inc., in association with Economic and Engineering Services, Inc. and the University of Michigan Department of Environmental Health prepared this report. This interim memorandum was written in March 1996 as part of Task 4 of the Distribution System Water Quality Modeling Project, DWSD contract number CS-1171. The report evaluated water quality in the distribution system storage reservoirs. The evaluation focused on chlorine decay and water age due to the reservoir's physical characteristics and operating conditions.

3.8.2 Transmission System Summary

At the time of this report, there were 19 storage reservoirs colocated with booster pump stations throughout the DWSD water transmission system. The total reservoir capacity in the system was 157 MG and the reservoirs ranged in size from 3.3 to 20 MG. Thirteen reservoirs (representing 83 percent of the total storage) are rectangular and have separate inlets and outlets. The remaining 17 percent of the storage is in six circular tanks with common inlet/outlet ports.

Chlorine levels and bacterial control are generally adequate in the system. However, there are some areas with low chlorine residual (defined as less than 0.15 mg/L). These areas have also experienced elevated heterotrophic bacteria plate counts. The study identified:

- Structural and hydraulic characteristics of existing storage reservoirs in the DWSD system
- Reservoir characteristics that may contribute to chlorine degradation
- Estimated magnitude of chlorine residual decay that typically occurs in the storage reservoirs
- Recommended modifications to improve chlorine residual maintenance in these reservoirs
- General design configuration guidelines for new reservoirs that could preclude excessive chlorine degradation

The study included monitoring, reviewing chlorine residual decay literature, bench-testing DWSD decays, creating a physical model of the Ford Road reservoir at the University of Michigan, and using computer models to evaluate the reservoirs' characteristics and operation.

3.8.3 Recommendations

Table 3-3 identifies and lists the relative influence and feasibility of the modifying factors (based on cost) that influence chlorine levels in DWSD storage reservoirs.

TABLE 3-3
Factors That Influence Chlorine Levels in DWSD Storage Reservoirs

Factor	Specific Characteristics /Conditions	Relative Influence on Chlorine Residuals	Relative Feasibility of Modifications to Enhance Chlorine Residuals
Physical	Capacity	Moderate	Very low
Reservoir	Shape	Moderate	Very low
Characteristics	Inlet/outlet configuration	High	Moderate
	Internal baffling	High	High
	Wall material	Low	Low
Operating Conditions	Rate of volumetric change	Moderate	Low
	Influent flow rate	High	Low
	Influent velocity	Moderate	Low
	Internal hydraulic mixing	High	Moderate/high

This report reached several conclusions regarding the general characteristics of DWSD reservoirs. Of most concern are circular reservoirs with inlet/outlet ports colocated on the reservoir bottom. They have a high potential for stagnation zones. Reservoirs of least concern are rectangular with the inlet separated from the outlet (both horizontally and vertically) or with multiple outlet ports. These reservoirs have a low or moderate potential for stagnation zones.

The report recommended improving chlorine residuals in the existing reservoirs through immediate, near-term, and long-term programs based on timing and the relative costs of implementation. Immediate recommendations included:

- Further hydraulic modeling studies to identify zones of influence for each reservoir
- An evaluation of temperature effects on the chlorine residual
- An evaluation of providing internal mixing in the reservoirs
- An evaluation of different fill/discharge operations, relocated ports, and internal baffling

Near-term recommendations included reconfiguring a test reservoir based on the immediate evaluations and evaluating its performance. Long-term recommendations are for reconfiguring appropriate reservoirs based on the findings from immediate and near-term evaluations.

The report's final recommendation was the adoption of guidelines for new reservoir construction. This included locating the inlet and outlet ports as far apart as practical, enhancing the sweep efficiency of fresh water entering the reservoir by providing internal baffling, and enhancing the level of mixing in the reservoir by providing hydraulic mixing.

3.8.4 Importance for CWMP

The study findings will be incorporated in the water quality analysis of the transmission system. Specifically, the report will be used in the sizing and configuration of new reservoirs identified in Task C2—Pumping and Storage Plan, Task C3—Regional and Suburban Transmission and Distribution Plan, and Task D3—Distributed Water Quality.

3.9 Water Supply Sanitary Survey (DRAFT)

3.9.1 Background Information

This report was written in September 1995 by TYJT in association with Malcolm Pirnie. It summarizes the results from a sanitary survey. The survey was recommended in the EPA's Surface Water Treatment Rule, which suggested including source, treatment, and distribution system evaluations and management/operations reviews. The study presented in this report was focused on the source water quality evaluation. The main purpose was to qualitatively assess and compare potential water quality problems at the Lake Huron and Detroit River raw-water intake locations and to identify likely sources of contaminants. The study focused on the contaminations that could potentially affect the ability of the DWSD water treatment facilities to meet State and federal drinking water standards. It was conducted in conjunction with a large-scale review of the City of Detroit drinking water supply system.

A review of the relevant water quality regulations, as well as a summary of source water intakes and the water treatment plants' capabilities, was provided. Historical source-water-quality characteristics including heavy metals, synthetic organics, nutrients, inorganics, and infectious organisms were also summarized. Moreover, potential contaminant sources, such as tributaries, point source discharges, and nonpoint source discharges were identified and discussed. Finally, variables that may impact the contaminant transport to the Lake Huron and Detroit River raw water intakes were qualitatively examined.

The study concluded that the Southwest Intake was at greatest risk because a large number of potential contaminant sources were located immediately upstream. The primary threats to source water for the Southwest Intake were:

- Fecal coliform and solids discharged from combined sewage overflows (CSOs) during wet weather events
- PCBs, mercury, and other metals from resuspended sediments resulting from dredging and high-wind events
- High-volume spills from industrial facilities within 5 miles upstream of the Southwest Intake, especially from those facilities using toxic or hazardous substances
- Fecal coliforms, metals, and solids from the Rouge River, especially during wet weather events

The Lake Huron intake water quality was acceptable and there was no indication of immediate threat to source-water quality for this intake. Water quality was acceptable at Belle Isle intake. Discharges and spills from various sources were not likely to have a great effect because most are located more than 20 miles from Belle Isle. The main concerns for this intake were:

- Migration of resuspended metal and PCBs downstream in the shallow Lake St. Claire.
- Development of fecal coliform and other infectious organisms in the summer.

The highest potential for significant sources of water contamination is likely in the spring because of large CSO discharges and contaminated agricultural runoff caused by rapid weather changes.

3.9.2 Recommendations

The following recommendations were suggested to reduce the vulnerability of source water to contamination: monitor the contaminant concentrations; set up a network of sampling locations and GIS system for mapping contaminants sources; and use computer models for modeling contaminants transport to the intakes.

3.9.3 Importance for CWMP

This source-water quality summary and information on the potential contaminant sources will be useful for developing strategies to protect the source supply quality and for developing emergency supply strategies in the event of loss of one or more intakes as described in Task D1—Source of Supply under Task D—Water Quality Management Plan.

3.10 Safe Drinking Water Act Response Program (Draft)

3.10.1 Background Information

This report was written in June 1995 by TYJT in association with CH2M HILL and Economic and Engineering Services, Inc. It presents DWSD existing water quality conditions and the evaluation results of its five water treatment plants in corresponding to the Safe Drinking Water Act (SDWA) Response Program. The Response Program was developed to help DWSD meet its service goal, which is to provide high-quality drinking water at adequate pressure and quantities and at reasonable cost. Specific objectives of the response program were:

- Identifying drinking water regulations that would affect DWSD and developing a plan to address them
- Evaluating the water plants and making recommendations to improve water quality and reliability
- Performing pilot plant tests to identify treatment improvements
- Making recommendations to improve distribution system water quality

DWSD's approach to this response program was broken into two parallel activities: evaluating existing water quality from the source through the treatment plants and the transmission system to the customers and evaluating each of the five water treatment plants. Water plant evaluation involves a review of the plant management, operations, physical facilities, design criteria, and maintenance. Based on the evaluation results and DWSD service goals, potential improvements to water quality management, water plant, maintenance, and additional study to meet existing and future regulations were discussed.

3.10.2 Water Treatment Plant Summary

DWSD owns and operates five Water Treatment Plants with a combined capacity of 1,640 MGD. The capacity and average production rate of each individual water plant are summarized in Table 3-4.

All five facilities use conventional treatment technology consisting of alum coagulation; mechanical or hydraulic rapid mixing and flocculation, sedimentation, dual media filtration, and chlorine disinfection. Each plant uses prechlorination before flocculation and sedimentation and post-chlorination after filtration. Fluoride is also added to the water and powered activated carbon (PAC) is used to control seasonal taste and odor problems. The amount of chemicals added is adjusted manually based on raw and finished water quality. Each plant has finished water clearwells and reservoirs to store treated water. The treated water is lifted into the transmission system by the high-service pump stations. At the reporting time, the treated water quality of DWSD complied with all the existing SDWA regulations with one minor exception on disinfection contact time (CT) requirement.

TABLE 3-4
Capacity and Average Production Rate of DWSD Water Treatment Plants

Treatment Plant	Year Constructed	Capacity (MGD)	Average Demand 1991–1994 (MGD)	Peak Hour Demand (MGD)
Water Works Park	1910-1935	320	102	256
Springwells	1931/1955	540	203	472
Northeast	1956	300	115	344
Southwest	1964	240	69	177
Lake Huron	1974	240	131	215

3.10.3 Study Recommendations

Recommendations on laboratory services, data management, water treatment plant operations and process improvements on coagulation control, settling basins, and filters were provided. The general major capital improvements needed to enhance water quality were flow measurement, chemical systems, settling, filtration, finished water reservoirs, and instrumentation and controls at all plants.

3.10.4 Importance for CWMP

This report contains a review of the drinking water regulations that can be used for CWMP Task A2—Evaluate Federal, State, and local Regulations. The recommended capital improvements can be incorporated into Task C6—Cost Estimates and Capital Improvement Program. The summary of the source water quality, treated water quality and treatment plant evaluations as well as various recommendations can be used for water quality control for Task D—Water Quality Management Plan.

3.11 Conceptual Design Report Mobile Research Laboratory Ozonation (Draft)

3.11.1 Background Information

This preliminary report was prepared in January 1995 by TYJT in association with CH2M HILL. It summarizes preliminary ozone pilot testing information, which will form a basis for further ozone feasibility evaluations of DWSD drinking water. Ozonation of drinking water will help DWSD to provide a more effective disinfection barrier against pathogens not affected by conventional chlorine disinfection. This process will also help to meet the forthcoming requirements of the Enhanced Surface Water Treatment Rule (ESWTR). Moreover, ozonation is helpful in reducing disinfection byproducts (DBPs) and improving water quality during periodic taste and odor episodes. Additional pilot tests and evaluations were planned through the spring and summer 1995.

The interim pilot testing was performed for both raw and settled water from the DWSD Southwest Water Treatment Plant. Ozone was generated from dry air. The results of ozone demand and decay and disinfection byproduct were provided. Based on the test results, a relatively low ozone demand compared to other U.S. surface waters was obtained. Meanwhile, there were low organic content and bromide levels in DWSD source waters. These results could suggest that low levels of DBPs will be found in future studies.

3.11.2 Study Recommendations

Recommendations for future ozone investigations including further pilot tests on ozone demand/decay, disinfection byproducts, effects of raw-and settled-water ozonation on the following treatment processes, and reductions of taste and odor compounds by ozone were suggested. Ozone equipment evaluation, review of the existing water plants for incorporation of ozone facilities, safety concerns, and cost estimates were also important for ozonation implementation.

3.11.3 Importance for CWMP

The information on ozonation provided from this report is useful for incorporating the recommendations into the CWMP.

3.12 Northern and Western Water Distribution Facility Plan Update— Hydraulic Analysis Interim Report

3.12.1 Background Information

Tucker, Young, Jackson, Tull, Inc wrote this report in November 1994. After the 1988 drought it became apparent that there were limits on the quantity of water delivered to the northern and western metropolitan areas served by DWSD's Lake Huron Water Treatment Plant, Imlay Station, and the North Service Center (NSC). This project's purpose was to review existing reports, forecast future water demands to these areas, and identify the facility improvements needed to meet them. This was accomplished by hydraulic analysis using KYPIPE2 and CYBERNET computer models. Demand projections were used from DWSD report E-266, Demand Projections—Water, September 1988.

A final report was never submitted. As authorized by the DWSD, this project was incorporated into the CS-1171 project, Water Demand Forecasts.

3.12.2 Transmission System Summary

Based on the early design reports, there were several system design parameters (SDP) identified for operating the northern and western areas of the DWSD system. These are summarized in the Table 3-5.

When this report was written, the DWSD system was run using parameters different than those originally anticipated. This is because the actual flow rate from Lake Huron WTP was lower than originally anticipated. These parameters were described as current operating parameters (COPs) and are summarized in Table 3-6. The report analyzed four specific hydraulic conditions described in Table 3-7. To analyze future facility updates needed for these conditions, the existing pumping capacities were determined and are summarized in Table 3-8.

3.12.3 Recommendations

The hydraulic analyses performed for this report led to two sets of recommendations. The interim recommendations were based on operating the system using the SDP instead of the COP. The long-term improvements were based on condition 4. Tables 3-9 and 3-10 summarize the recommendations.

3.12.4 Importance for CWMP

The hydraulic analyses performed and recommendations made will be evaluated for use in Task C—Water Supply and Service Management Plan. Current information regarding DWS-812, Imlay Station Improvements, will also be used to update the recommendations made in the study.

TABLE 3-5
Operational System Design Parameters for DWSD Transmission System

Location	Pressure (psi)
Lapeer	60 min.
Potter and Baxter	40 min.
96-inch Main High Points	15 min.
Rochester	30 min.
NSC Inlet to I-valves	66 max, 100 emergencies
NSC Pump Suction	35 max.

TABLE 3-6
Current Operating Parameters for DWSD System

Location	Pressure (psi)
Lake Huron WTP	170–180
Imply Station	80–100
Dorsey and Dickerson	70–90
Potter and Baxter	40–60
Lake George and Bowers	20 min.

TABLE 3-7
Specific Hydraulic Conditions Analyzed

Condition	Operational Mode	Demand Allocated
1	Imlay Station out of service (LH pumps direct to Flint and the NSC)	Avg. day 1990 Max. hour 1990
2	Imlay Station pumping west to Flint (LH pumps direct to the NSC)	Avg. day 1990 Max. hour 1990
3	Imlay Station pumping west to Flint (LH pumps direct to the NSC)	Avg. day 2025 Max. hour 2025
4	Imlay Station pumping west to Flint and south to the NSC	Avg. day 2025 Max. hour 2025

TABLE 3-8
Facility Pumping Capacities (MGD)

Location	Pump Information	Installed Capacity	Firm Capacity (with Largest Pump Out of Service)
Lake Huron WTP			
High-lift	5 pumps @ 60 MGD	300	240
NSC			
Line Pumps	5 pumps @ 30 MGD (high speed)	150	120

TABLE 3-9
Interim Improvements

Location	Future Installed Capacity	Future Firm Capacity	Facility Improvement
Lake Huron WTP (High-lift)	300 MGD	240 MGD	One additional pump to provide a min. capacity of 20 MGD
NSC (Line pumps)	240 MGD	210 MGD	Three additional pumps rated at 30 MGD each and an additional pump rated at 30 MGD as a standby
Booster Station for Washington Twp.			Washington Twp. To provide Booster Station to meet their system requirements

TABLE 3-10
Long-Term Improvements

Location	Future Installed Capacity	Future Firm Capacity	Facility Improvement
Lake Huron WTP (High-lift)	460 MGD	400 MGD	Three additional pumps rated at 30 MGD each
NSC (Line pumps)	360 MGD	330 MGD	Additional 210 MGD of pumping capacity
Booster Station for Washington Twp.			Not required

3.13 Energy Optimization of Water Distribution Systems

3.13.1 Background Information

Tucker, Young, Jackson, Tull, Inc. for the City of Detroit's Energy Task Force of the Urban Consortium wrote this report in September 1994 for Technology Initiatives. The purpose was to develop an energy optimization computer program to identify the most energy-efficient pump combinations for the high-lift pumps at the treatment plants and at the booster stations to meet system demands and pressures. The DWSD water system in 1994 was run based on pressure and uses pumping to supply adequate operating pressures in the system through the Systems Control Center (SCC) located in the Water Board building in downtown Detroit. The annual costs for this operation approached $20 million. This report used information such as daily pump and pressure logs, annual reports from fiscal years 1987–88 through 1991–92 and the computer programs KYPIPE2 and KYPUMP to help assess these energy costs and pump combinations.

3.13.2 Transmission System Summary

At the time of this report, the DWSD water distribution system consisted of 750 miles transmission mains (24 inches and larger) and 20 booster stations receiving treated water from five water plants. There was 363 MG of ground storage in the system, 60 pressure-monitoring points, and three pressure zones. The operators at the SCC selected pumping combinations to maintain acceptable pressures throughout the system. However, selection of pumps was based on operators' experience and was typically accomplished without regard to energy cost.

3.13.3 Water Treatment Plant Summary

There are five water treatment plants in the DWSD system. This report used Fiscal Year 1991–92 data for the following plant capacities and maximum day demands.

TABLE 3-11
DWSD Water Treatment Plant Capacities and Maximum Day Demands

Treatment Plant	Plant Capacity (MGD)	Maximum Day Demand (MGD)
Water Works Park	320	190
Springwells	540	388
Northeast	300	281
Southwest	240	125
Lake Huron	240	214

The low-pressure zone is fed from Water Works Park Treatment Plant's (WWP) high lift pumps delivering water at 70–80 psi and subsequently reduced to 50–60 psi before delivery to the downtown area. If water pressures supplied by WWP falls below 40 psi, three cone valves open automatically and the low-pressure zone is supplied by Springwells. The intermediate district, which includes southwest Detroit and the downriver suburbs, is fed by WWP at 70–80 psi, Springwells at 65–75 psi and the Southwest plant at 70–85 psi. The high-pressure zone includes northern Detroit and the North and Northwest suburbs, reaching as far as Pontiac and Flint, and is fed by the Northeast plant at 70–85 psi, Springwells at 55–85 psi, and the Lake Huron plant at 160–180 psi.

3.13.4 Recommendations

This report was written to provide a computer tool to aid SCC operators in selecting pumps to meet target pressures in the system, which accomplishes the task in the most energy efficient manner. The implementation and use of this tool as recommended identified expected savings of $225,000 to $2.5 million annually.

3.13.5 Importance for CWMP

The energy optimization program is currently being expanded under a separate task for the CS-1272 project, Study and Evaluation of DWSD Electric Utility Rates. This program will be used for the Comprehensive Master Plan, Task C—Water Supply and Service Management Plan. Under this task the program will be used to evaluate pumping operations within the constraints of the model capabilities.

3.14 Lead and Copper Corrosion Control Optimization Study

3.14.1 Background Information

This report was prepared in May 1994 by TYJT in association with CH2M HILL and Economic and Engineering Services. The purpose was to assist DWSD in determining the best way to comply with the SDWA Lead and Copper Rule and to develop full-scale implementation approaches. This report summarized the existing corrosion conditions in the DWSD system and identified the major water quality concerns associated with corrosions, particularly those associated with lead releases. Desktop analyses of feasible and practical treatment alternatives to reduce lead levels in customers' tap water were provided. Moreover, the proposed alternatives were further evaluated through the pilot plant testing based on the evaluation criteria developed. Finally, the recommended process for implementing lead corrosion control treatment in the DWSD facilities was described along with the chemical selection, equipment needed, cost analysis, and monitoring requirements.

Lead uptake was the major corrosion-related problem in DWSD's water system. Utilization of lead service lines was a major reason for the high lead levels in the tap water. Corrosion of other piping materials does not appear to be as significant a concern as the corrosion of lead-bearing materials.

The lead and copper levels in the source waters were low and generally below the analytical detection limits. The corrosion-related water quality parameters for each of the three sources and the treated water were similar. The treated water had characteristics expected to be moderately aggressive toward metallic piping materials. The pH and alkalinity of the treated water is stable throughout the entire distribution system.

The sources of lead in tap water in the DWSD system that were of greatest concern included lead service lines, interior lead plumbing in older residences, and lead-soldered copper plumbing; brass plumbing fixtures and water meters; and galvanized pipes.

The lead action level (AL) of 15 µg/L at the 90th percentile was exceeded by more than one-third of the water purveyor systems served. Overall, about 20 percent of all DWSD sampling sites exceeded the lead AL. About 40 percent of the total DWSD sampling sites that have lead service lines exceeded the lead AL, while only 8 percent of the total copper service line sites exceeded the AL. None of the purveyor systems served by DWSD exceeded the copper AL of 1.3 mg/L.

3.14.2 Study Recommendations

Based on the evaluations of the pilot testing results, adding orthophosphates was recommended as the optimum alternative for full-scale application as a lead-corrosion-control treatment.

3.14.3 Importance for CWMP

The discussed lead- and copper-level control methods will be used as a basis for evaluation and the recommendation of improving water quality control in the treated water and the water in the distribution system. This is Task D4—Regulatory and Contract Compliance.

3.15 Report Study of Water Works Park Plant & Water Transmission System (Volume 1)

3.15.1 Background Information

This report was prepared in September 1981 by Hazen & Sawyer, Inc., and Smith, Hinchman & Grylls Associates, Inc. in association with Harza Engineering Company Consulting Engineers. The purpose of this Water Works Park Treatment Plant (WWP) and water transmission system study was to determine the best use of WWP in conjunction with other components of the DWSD system and to develop an overall plan to meet the projected 2020 water demand. Alternatives considered included process alternatives at WWP combined with system-wide alternatives for the DWSD service area. Four basic water treatment plant alternatives for WWP were formulated, and 4 of the 10 system-wide alternatives were selected for detailed analysis.

3.15.2 Treatment Plant Summary

The Water Works Park Treatment Plant was built between 1910 and 1935. Due to its age, rehabilitation was suggested in order to maintain service through 2020. According to this report, the reliable capacity of the WWP was estimated at 320 MGD, but major rehabilitation is needed to retain this capacity.

There are five water treatment plants serving the DWSD water system. According to this report, the combined reliable production capacity of the other four treatment plants was estimated at 1,290 MGD. With minimum modifications, this capacity could be increased to 1,620 MGD. The existing and potential capacities of the individual plants identified in this study are summarized in Table 3-12.

TABLE 3-12
Existing and Potential Capacity of the DWSD Water Treatment Plants (1981)

Treatment Plant	Year Constructed	Capacity (MGD)	Potential Reliable Capacity (MGD)
Springwells	1931–1955	540	600
Northeast	1956	300	340
Southwest	1964	210	280
Lake Huron	1974	240	400
Subtotal		**1,290**	**1,620**
Water Works Park	1910–1935	320	320
Total		**1,610**	**1,940**

Four basic water treatment plant alternatives for WWP were formulated based on the projected water demand and detailed assessment of DWSD facilities. The four alternatives were:

- Eliminate treatment at WWP
- Rehabilitate the WWP plant to a reliable treatment capacity of 350 MGD
- Rehabilitate WWP to 500 MGD capacity
- Construct a new plant with a treatment capacity of 500 MGD

3.15.3 Transmission System Summary

At the time of this report, there were 20 booster stations and nearly 700 miles of transmission mains in the DWSD system. The system was generally capable of meeting existing peak demands with all five treatment plants operating. Some areas, however, have experienced problems during high demands. Flow and pressure demands will not be adequately met without major improvements to the transmission system.

Future DWSD water needs were established based on projections of population, land use, service area, and water consumption. The population served by DWSD is expected to increase from 3,787,000 in 1980 to 4,791,000 in 2020. Average day water demand is expected to rise from 752 MGD in 1980 to 917 MGD in 2020. If all potential users of the DWSD system were served, the peak-day demand would increase to 1,945 MGD.

Transmission system improvements necessary to meet these demands are somewhat dependent on the future use of treatment plants for the DWSD system. Some common elements include the construction of new transmission lines, construction of a second connection to Flint and other areas northwest of Detroit, and improvements to various pumping stations. Ten system-wide alternatives to supply these future needs were developed. These alternatives incorporated various combinations of the treatment plants' existing and potential capacities and incorporated a plan of transmission system improvements and additions required to adequately supply 2020 demands.

3.15.4 Recommendations

The alternatives were evaluated on the basis of capital costs, operation and maintenance costs, present worth, and a set of non-monetary criteria, including capability and flexibility of the transmission system, ease of operation, energy requirements, public acceptability, and environmental impacts. The last alternative was recommended because it made the best use of the existing plants, provided considerable flexibility of the transmission system improvements, and had the lowest cost. The major components of this alternative were:

- Rehabilitate WWP plant to 350 MGD reliable capacity, with a peak-day production of 265 MGD.
- Add new pumps to Southwest, Northeast, and Lake Huron water treatment plants.
- Construct transmission mains connecting Adams to Franklin Station, and Joy Road Station to Ypsilanti Station.
- Construct a new outlet transmission main from the Southwest treatment plant and reinforce other parts of transmission system.
- Implement measures to protect the Lake Huron to Imlay Station transmission main from potential transient problems.
- Construct one pipeline to provide secondary supply of water to Flint with a new pump station and increase the capacity of the Imlay, North Service Center, Franklin, Adam, and Wick Stations.

3.15.5 Importance for CWMP

The report is nearly 21 years old and some of the recommendations have already been acted on. Other report recommendations that have not been initiated will be evaluated and used in future analyses as part of CWMP Tasks C and D.

4. Summary of the Great Lakes Water Quality Initiative (GLI)

4.1 Background

In 1990, Congress amended Section 118 of the Clean Water Act to require the U. S. Environmental Protection Agency (EPA) to publish "water quality guidance" for the Great Lakes system. Under Section 118, the GLI must conform to the objectives and provisions of the Great Lakes Water Quality Agreement between the U.S. and Canada. Also, the GLI must be no less restrictive than the Clean Water Act's national water quality criteria.

4.2 GLI Summary

4.2.1 Overview

The Great Lakes Water Quality Initiative (GLI) is a set of regulations published by U.S. EPA on March 23, 1995 and codified in 40 CFR part 132 with the title of "Water Quality Guidance for the Great Lakes System." It identifies minimum water quality standards, anti-degradation policies, and implementation procedures to protect human health, aquatic life, and wildlife in the Great Lakes System.

The GLI will help to establish consistent, enforceable, long-term protection from all types of pollutants, but will place short-term emphasis on the types of long-lasting pollutants that accumulate in the food web and pose a threat. It consists of water quality criteria for 29 pollutants and detailed methodologies to develop criteria for additional pollutants; implementation procedures to develop more consistent, enforceable water quality-based effluent limits in discharge permits, as well as total maximum daily loads of pollutants e allowed to reach the Lakes and their tributaries from all sources; and anti-degradation policies and procedures.

The GLI provisions will also help establishing consistent goals or minimum requirements for Remedial Action Plans (RAPs) and Lakewide Management Plans (LaMPs) that are critical to the success of international multi-media efforts to protect and restore the Great Lakes ecosystem.

Under the Clean Water Act, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin were required to adopt provisions consistent with the GLI into their water quality standards and NPDES permit programs by March 23, 1997, or EPA would have been required to promulgate the provisions for them. Michigan adopted the GLI in July 1997.

4.2.2 GLI Details

40 CFR Part 132 includes the detailed methodologies, policies, and procedures for adoption of criteria by Great Lakes States and Tribes, application of methodologies, and implementation of procedures for EPA review as described in its six appendixes (A through F). The Great Lakes Water Quality Initiative methodologies for developing of aquatic life criteria and values; bioaccumulation factors; human-health criteria and values; and wildlife criteria are described in Appendix A to D, respectively. Appendix E presents GLI anti-degradation policy. The last appendix describes the GLI implementation procedures.

The following sections provide a brief summary for each of the water quality, implementation procedures, and anti-degradation provisions in GLI.

4.2.2.1 Water Quality Criteria and Methodologies

Protection of Aquatic Life: The final Guidance contains both acute and chronic water quality criteria for 15 pollutants to protect aquatic life from acute and chronic exposures to pollutants. Table 4-1 lists these 15 chemicals. They are derived to establish ambient concentrations for pollutants, which, if not exceeded, will protect fish, invertebrates, and other aquatic life in the Great Lakes System from adverse effects due to that pollutant.

TABLE 4-1
Pollutants That Have Water Quality Criteria to Protect Aquatic Life

Arsenic (III)	Endrin	Selenium	Nickel
Chromium (VI)	Lindane	Cadmium	Pentachlorophenol
Cyanide	Mercury (II)	Chromium (III)	Zinc
Dieldrin	Parathion	Copper	

A two-tiered methodology to derive Aquatic Life Criteria (Tier I) or Values (Tier II) for additional pollutants discharged to the Great Lakes System was described.

Protection of Human Health: The final Guidance contains numerical human-health criteria for 18 pollutants (see Table 4-2) in ambient water, and includes Tier I and Tier II methodologies to derive cancer and noncancer human health criteria for additional pollutants. Tier I human-health criteria are derived to protect individuals from adverse health impacts due to the consumption of aquatic organisms and water, including incidental water consumption through recreational activities in the Great Lakes System. Chronic criteria are derived for each chemical to reflect long-term consumption of food and water from the Great Lakes System. Tier II values are intended to provide a conservative, interim level of protection in the establishment of a permit limit, and are distinguished from the Tier I approach by the amount and quality of data used for derivation.

Protection of Wildlife: The Guidance includes both numerical criteria for four pollutants to protect wildlife in ambient water and a methodology to derive Tier I criteria for additional bioaccumulative chemical of concerns (BCCs). The four identified are DDT and metabolites; mercury including methylmercury; PCBs and 2,3,7,8 -TCDD. Wildlife criteria are derived to establish ambient concentrations of chemicals that, if not exceeded, will protect mammals and birds from adverse impacts from that chemical due to consumption of food and/or water from the Great Lakes System.

TABLE 4-2
Pollutants Identified to Protect Human Health

Benzene	Dieldrin	Lindane	Toxaphene
Chlordane	2,4-Dimethylphenol	Mercury	Trichloroethylene
Chlorobenzene	2,4-Dinitrophenol	Methylene Chloride	
Cyanides	Hexachlorobenzene	2,3,7,8-TCDD	(Including Methylmercury)
DDT	Hexachloroethane	Toluene	

Pollutants Subject to Federal, State, and Tribal Requirements: Table 4-3 lists the parameters which are subject to federal, State and tribal requirements.

TABLE 4-3
Pollutants Subject to Federal, State, and Tribe Requirements

Alkalinity	Chlorine	pH	Total and Suspended Solids
Ammonia	Color	Phosphorus	Turbidity
Bacteria	Dissolved Oxygen	Salinity	
BOD	Dissolved Solids	Temperature	

4.2.2.2 Bioaccumulation Methodology

Bioaccumulation refers to the uptake and retention of a substance by an aquatic organism from its surrounding medium and from food. The final Guidance identifies 22 bioaccumulative chemicals of concern (BCCs) targeted for special controls. The following table tabulates these 22 BCCs.

TABLE 4-4
Bioaccumulative Chemical of Concerns

Chlordane	Hexachlorobutadiene	Mercury	1,2,3,4,-Tetrachlorobenzene
4, 4' – DDD	Hexachlorocyclohexane (BHC)	Mirex	1,2,4,5,-Tetrachlorobenzene Toxaphene
4, 4' – DDE	Alpha-BHC	Octachlorstyrene	
4, 4' – DDT	Beta-BHC	Pentachlorobenzene	Photomirex
Dieldrin	Delta-BHC	Polychlorinated biphenyls (PCBs)	Gamma - BHC
Hexachlorobenzene (HCB)	Lindane	2,3,7,8-TCDD (Dioxin)	

4.2.2.3 Implementation Procedures

This section of the Final Guidance contained nine specific procedures for implementing water-quality standards and developing National Pollution Discharge Elimination System (NPDES) permits to attain the standards. The nine procedures are site-specific modifications, variances from water quality standards for point sources, total maximum daily load (TMDL) and mixing zones, additivity, determining the need for water quality-based effluent limitation (WQBEL), intake pollutants, whole effluent toxicity (WET), loading limits, quantification levels, and compliance schedules.

4.2.2.4 Anti-degradation Provisions

EPA's existing regulations, 40 CFR 131.6, establish an anti-degradation policy as a minimum requirement of an acceptable water-quality standards submittal. Section 131.12 describes the required elements of an anti-degradation policy. These are protection of water quality necessary to maintain existing uses and protection of water quality in those bodies of water identified as outstanding National resources.

The GLI provided detailed procedures for implementing anti-degradation that were not part of the existing regulations. The detailed implementation procedures were intended to result in greater consistency in how anti-degradation is applied throughout the Great Lakes System. The Guidance specified, among other things, how high-quality waters should be identified, what activities should require review under anti-degradation, and the information necessary to support a request to lower water quality and the procedures to be followed by a Tribe or State in making a decision whether or not to allow a lowering of water quality. Meanwhile, it also allows Tribes and States greater flexibility in how anti-degradation is implemented.

4.3 Importance for CWMP

The GLI was implemented mainly to provide for the development of uniform water quality criteria and implementation procedures for the Great Lakes. A major thrust of the initiative was to limit toxic discharges to the lakes. It is expected that criteria from the Guidance will primarily affect effluent limitations for the point source discharges. Consequently, changes in the discharge limits will have a long-term beneficial effect on DWSD source water quality.

Combined sewer overflows (CSOs), one of the biggest contributors of toxic pollutants to the Great Lakes Basin, are not directly regulated under the GLI except that procedure 3.B.8 of appendix F, GLI requires that TMDLs must consider discharges from wet-weather events, when stormwater fills sewers. They carry domestic and industry wastes and are dumped directly into waterways.

Chlorine and ammonia, common and highly toxic pollutants throughout the Great Lakes Basin, are excluded from the GLI's list of “Pollutants of Initial Focus” (GLI Table 6).

Implementation of the GLI can only improve Great Lakes water quality, and it is unlikely that the drinking water standards will be affected.

4.4 Contact with International Joint Commission (IJC)

We have contacted the IJC to discuss and review the Great Lakes Initiatives (GLI) as they may relate to DWSD's water system. However, IJC does not maintain monitoring plans for the Detroit River. They rely on the information from both American and Canadian governments and other sources to assess progress under the Great Lakes Water Quality Agreement (GLWQA). The two nations' Coast Guards have joint spill contingency plans for the Detroit River.

5. Safe Drinking Water Act (SDWA) 1996 Amendments

5.1 Summary of the Safe Drinking Water Act (SDWA) 1996 Amendments

5.1.1 Introduction

On August 6, 1996, President Clinton signed the 1996 Safe Drinking Water Act Amendments, which will bring substantial changes to the national drinking water program for water utilities, States, and the EPA. The amendments will also provide greater protection and information to the 240 million Americans served by public water systems.

These changes will correct today's problems and help the EPA, States, and water systems prepare for future drinking water safety challenges as well as ensure the sustainable availability of safe drinking water. The amendments increased State flexibility, provided for more efficient investments by water systems, gave better information to consumers, and strengthened EPA's scientific work, including the use of risk and cost-benefit considerations in setting drinking water standards.

Four themes characterized the areas of greatest change. Together, they comprised a balanced and integrated framework of reform, and represented a major national commitment to:

1. New and stronger approaches to prevent contamination of drinking water
2. Better information for consumers, including the "right to know"
3. Regulatory improvements, including better science, prioritization of effort, and risk assessment
4. New funding for States and communities through a Drinking Water State Revolving Fund.

5.1.2 New and Stronger Prevention Approaches

The 1996 SDWA Amendments established a strong new emphasis on source-water protection and enhanced water-system management. This emphasis transformed the previous law from its "after-the-fact" regulatory focus into a truly anticipatory statute that can better provide for the sustainable use of water by our nation's public water systems and their customers. The States will be central in creating and focusing prevention programs, and helping water systems to improve operations and avoid contamination problems.

Source Water Protection: The Amendments required States to submit a program to delineate source-water areas of public water systems and to assess their susceptibility to contamination. The program had to be submitted within 18 months of EPA's publication of the guidance. The completed source-water assessment results must be made available to the public and are a statutory prerequisite for State-tailored monitoring programs in that they can provide a scientific basis for such tailoring. The source-water assessment results will also provide the information necessary for water systems to seek help from States in protecting source water, or initiating local government efforts.

Capacity Development: The 1996 Amendments created a national program that builds on the demonstrated success of several States in strengthening the managerial, technical, and financial capacity of water systems to reliably deliver safe drinking water. EPA was required to review existing State programs and publish guidance for their use to meet the new requirements. State programs must have two main components:

(1) Legal authority to ensure that new water systems have sufficient technical, managerial, and financial capacity to meet drinking water standards

(2) Strategies to identify and assist existing water systems needing improvements in managerial, technical, or financial capacity or aid to comply with standards.

One objective may be to better enable States to set priorities for technical and compliance assistance efforts, focusing on those systems the strategy identifies as most in need of assistance. Another may be to help systems review their own characteristics, strengths, and shortcomings in light of future plans and expectations, working with the State or through EPA's use of the State's analysis capacity.

Operator Certification: The Amendments require all States to carry out a program of operator certification to ensure that public water system operators have appropriate and current knowledge and skills. This program's objectives of should be to ensure that every water system has an operator trained and certified to the level that each State determines is appropriate to the system's functions, facilities, and operations.

5.1.3 Better Consumer Information / "Right-to-Know"

In addition to the much-discussed new requirement for systems to prepare consumer confidence reports, the Amendments frequently specify that the public be provided with or given access to other data collected, analyses done or implementation strategies developed under new SDWA programs.

Consumer Confidence Reports: According to the Amendments, within 2 years, EPA must issue regulations requiring all community water systems to prepare and mail to each customer at least annually a report with information about the system's source water and the level of contaminants in the drinking water purveyed.

Some Other Provisions for Improved Consumer Information: The Amendments required that persons served by a public water system must be given notice of any violation of a national drinking water standard "that has the potential to have serious adverse effects on human health as a result of short-term exposure" within 24 hours after the violation by at least one effective means, and written notice of any other violation of a national standard or monitoring requirement within 1 year. States also must "make readily available to the public" an annual report to the Administrator on violations of national primary drinking water regulations by public water systems within the State.

5.1.4 Regulatory Improvements

A decade of experience revealed several areas where responsible, science-based flexibility and a better prioritization of effort could improve protection of public health compared to the "one-size-fits-all" approach of under the 1986 SDWA.

New Risk-Based Contaminant Selection: The amendments eliminated the previous requirement that EPA regulates an additional 25 contaminants every 3 years. Instead, EPA has the flexibility to decide whether or not to regulate a contaminant after completing a required review of at least 5 contaminants every 5 years. Three criteria must be used by EPA to determine whether or not to regulate a contaminant if:

1) it adversely affects human health
2) it is known or substantially likely to occur in public water systems frequently and at levels of public health concern
3) its regulation presents a meaningful opportunity for health risk reduction.

Occurrence Information: Unregulated Contaminants, National Database, Information Collection: Under the new law's risk-based regulatory framework, the collection, organization and ready availability of contaminant occurrence data took on unprecedented importance. EPA was required to issue regulations establishing criteria for monitoring of unregulated contaminants, and, within 3 years after enactment and every 5 years thereafter, EPA must issue a list of no more than 30 such contaminants for which monitoring was required. In addition, for the first time, a national occurrence database covering regulated and unregulated contaminants will be established, primarily using compliance monitoring detection data and information from the unregulated contaminant-monitoring program.

Cost-Benefit Analysis and Research for New Standards*:* For all future drinking water standards, EPA will conduct a thorough cost-benefit analysis and provide comprehensive and understandable information to the public. EPA was also required to use the "best available, peer-reviewed science and supporting studies" in carrying out actions within the standard setting section "to the degree that an Agency action is based on science."

In these Amendments, standard setting had new flexibility compared to the previous law. After first defining a maximum contaminant level (MCL) or treatment technique standard based on affordable technology, as done previously, EPA must determine whether the costs of that standard would be justified by the benefits. If not, then EPA may adjust a MCL to a level that "maximizes health risk reduction benefits at a cost that is justified by the benefits."

Small-System Technologies, Variances, and Exemptions*:* Setting standards based on technology that large systems could afford without recognizing the often-different economics of small systems is a fundamental problem with the previous law. To correct this, the new law contained multiple remedies that included:

- Requiring EPA to identify technologies that comply with the standard and are specifically affordable for smaller systems as part of a new drinking water standard
- Identifying a "variance" technology where such technologies do not exist for a certain group of smaller systems or quality of source water.

Compliance Time Frames: The Amendments extended the previous, unworkably short 18-month deadline to 3 years for systems to comply with new regulations, unless EPA determines an earlier date is "practicable."

Monitoring Reforms: Under the new law, States may grant "interim monitoring relief" to systems that serve populations of less than 10,000 if the monitoring performed at the time of "greatest vulnerability to the contaminant" fails to detect it, and the State finds that further monitoring is unlikely to detect it. This relief may not cover any microbiological contaminants (or their indicators), disinfectants, or disinfection or corrosion byproducts.

Arsenic: The Amendments required EPA conduct additional research on arsenic, particularly the health effects at low levels of exposure, after consultation with National Academy of Sciences (NAS) and others. EPA was required to propose a regulation not later than January 1, 2000, and issue a final regulation by January 1, 2001.

Radon: EPA should publish a health risk reduction and cost analysis associated with possible maximum contaminant levels within 30 months of enactment. Within 3 years after enactment, EPA is to propose a maximum-contaminant-level goal and drinking water regulation for radon.

DBPs/Cryptosporidium: EPA should promulgate an Interim Enhanced Surface Water Treatment Rule, a Final Enhanced Surface Water Treatment Rule, a Stage I Disinfectants and Disinfection Byproducts Rule, and a Stage II Disinfection Byproducts Rule in accordance with a February 10, 1994, *Federal Register* notice.

EPA may use "risk-risk" considerations in setting DBP Stage I and II standards. The "considerations used in the development of the [DBP] proposal" shall be treated as consistent with the risk-risk authority for the purposes of the Stage I and Stage II DBP rules.

Sulfate*:* A dose-response study for sulfate was to be conducted within 30 months by EPA jointly with the Centers for Disease Control and Prevention. Sulfate would thereafter be considered in the first round of the new contaminant selection process.

5.1.5 A Drinking Water State Revolving Fund for States and Communities

The creation of a Drinking Water State Revolving Fund (SRF) to assist communities in installing and upgrading safe drinking water treatment facilities was among the new statute's most dramatic departures from the past and among the most important changes in the nation's drinking-water program since passage of the original SDWA in 1974.

Drinking Water State Revolving Fund: The SRF was authorized at $599 million for fiscal year 1994, and $1 billion annually through fiscal year 2003. Funds were allotted to all primacy States through fiscal year 1997 based on the results of the most recent SRF needs survey.

SRF Grants to States for Prevention: Programs and Projects: One of the most notable features of new law was the authorization to States to use SRF funds for new prevention programs.

5.2 Michigan Source Water Assessment Program (SWAP)

The 1996 amendments to the federal Safe Drinking Water Act (SDWA) required States to identify the areas that supply public drinking water; inventory contaminants and assess water susceptibility to contamination; and inform the public of the results. In compliance with the Amendments, the Michigan Department of Environmental Quality (MDEQ) completed an EPA-approved Source Water Assessment Program (SWAP) in February 1999 (approved on October 1999).

In this SWAP program, surface water assessments and several source water protection programs are of importance to the Comprehensive Water Master Plan. Surface water assessments evaluate microbial water quality and disinfection byproduct precursors. These will be key factors in determining the level of treatment that will be required under the future Enhanced Surface Water Treatment Rule as well as Stage 1 and 2 Disinfection Byproduct Rules.

Source water protection programs directed to Michigan surface water supplies include State regulations for proper placement and construction of water plant intakes and issuance of National Discharge Elimination System (NPDES) permits by Surface Water Quality Division (SWQD) for point source discharges. The SWQD is also active in controlling nonpoint source discharges to surface waters through programs such as Clean Water Act Section 319 projects.

Michigan voters passed a Clean Michigan Initiative on November 3, 1998 to allocate bond funds for source water protection activities such as controlling nonpoint source discharges to surface waters and the abandonment of wells.

Overall, the implementation of these programs will help improving the source water quality for the DWSD water supply system.

5.3 Comprehensive SDWA Regulatory Update

Amendments to the reauthorized SDWA require compliance with new drinking water regulations within 3 (or in some cases up to 5 years) if significant capital construction is required. Current regulatory trends should be considered by water utilities in strategic planning so that compliance with new rules may be achieved within the required time frames. For this purpose, the scope, status, and schedules for new regulations under development by the EPA are summarized in Table 5-1, and more details will be discussed thereafter.

TABLE 5-1
Proposed and Pending Rules (March 2002)
Association of Metropolitan Water Agencies (AMWA) Regulatory Update at a Glance—Proposed and Pending Rules, March 2002

Rule/Notice	Proposal	Final	Description/Status
Final Arsenic Rule Review	Proposed July 19, 2001	Final Rule become effective on February 22, 2002	EPA let the January 2001 final Arsenic Rule become effective on February 22, 2002 without any additional comment. EPA has moved into the implementation phase on the Arsenic Rule.
Stage-2 MDBP Rules	Expected mid-2002	EPA expects to finalize the rules in mid-2003, missing the May 2002 SDWA deadline	EPA is developing proposed Stage-2 MDP rules based on the Federal Advisory Committee (FACA) "Agreement in Principle." EPA staff is reviewing stakeholder comments on the draft proposed State-2 DBPR and LT2ESWTR circulated in December and January. EPA's Science Advisory Board is reviewing the scientific and technical basis for the rules.
Ground Water Rule	Proposed May 10, 2000	May 2002 SDWA deadline; rule expected late 2002	The proposed rule includes periodic sanitary surveys, source-water monitoring for at-risk systems and a disinfection requirement for presently undisinfected system when deficiencies cannot be corrected.
Radon Rule	Proposed November 1999	Final rule expected late 2002 - missing August 2000 deadline	EPA proposed an MCL of 300 and an AMCL of 4,000 pCi/L. EPA missed the August deadline for a final rule and expects to finalize it in late 2002.
Contaminant Condidate List (CCL)	Proposed determinations expected early 2002	Final determin-ations expected in late 2002 - missing the SDWA dead-line of August 2001	EPA is reviewing the status of 12 contaminants that are designated as "regulatory determination priorities" on EPA's CCL. It is expected that EPA will decide to regulate aldrin, dieldrin, and metolachlor and make determinations for six others.
Total Coliform Rule (TCR) Revisions and Distribution System Issues	Advanced Notice of Proposed Rulemaking expected early 2002	Final Rule by 2005, at the latest	EPA has apparently decided to revise the TCR as part of the agency's Six-Year Review of existing regulations. EPA is also considering expanding the TCR to include other distribution system concerns. and is preparing a series of white papers to address such issues as cross-connection control.
Six-Year Review	Proposed determinations expected in early 2002	Final determin-ations expected late 2002. SDWA deadline of August 2002	EPA plans to publish an advanced notice of rulemakings for revised regulations under the 6-year review process. At this time, no decisions have been made whether to revise any current rule except the TCR.
Chlorine Gas Listed as Restricted Use	Notice published in Federal Register on September 18, 2000	Final notice expected sometime in mid-2002	EPA has proposed to make chlorine-gas-use at water and wastewater facilities a restricted use pesticide under the Office of Pesticides Programs. EPA will postpone the final decision on the registration eligibility of chlorine gas as a restricted pesticide while the agency evaluates current and possible training under drinking water programs.
Cross-Media Electronic Reporting and Record-Keeping Rule (CROMERRR)	Proposed August 31, 2001 by EPA's Office of Electronic Information (OEI)	Final Rule schedule has not been determined	CROMERRR proposes conditions under which EPA would allow submission of electronic documents and maintenance of electronic record to satisfy federal environmental reporting and record-keeping requirements in agency regulations. Public comment on the proposed rule was extended to February 27.

Arsenic Rule: As expected, EPA let the January 2001 final Arsenic Rule become effective on February 22, 2002 without additional comment. Once EPA Administrator Christine Todd Whitman announced in October 2001 that the standard will be set at 10 ppb and the 2006 compliance date set by the Clinton administration would remain in effect. EPA could let the final rule become effective by taking no action, and has moved into the implementation phase on the Arsenic Rule.

Stage-2 Microbial and DBP Rules: EPA is continuing to develop the proposed Stage-2 Microbial and Disinfectant Byproducts (MDBP) rules based on the Federal Advisory Committee "Agreement in Principle."

Ground Water Rule: The proposed rule, published on May 10, 2000, included periodic sanitary surveys, source-water monitoring for at-risk systems, and a disinfection requirement for presently undisinfected systems when deficiencies cannot be corrected. In its comments on EPA's proposed Ground Water Rule, AMWA raised serious concerns about EPA linking corrective actions for significant deficiencies (from sanitary surveys) to a treatment technique violation. EPA is considering substantive changes in the final rule in order to simplify the regulation. Due to other regulatory priorities, the Ground Water Rule has been delayed until late 2002.

Radon Rule: EPA is in the process of developing the final Radon Rule and believed to be considering different approaches to the rule. EPA proposed an MCL of 300 pCi/L and an Alternative MCL (AMCL) of 4,000 pCi/L. To comply with the AMCL, water systems would have to either participate in a State-run multimedia mitigation (MMM) program or run their own MMM programs.

EPA missed the August 2000 SDWA deadline for finalizing the Radon Rule. EPA is still weighing options to maximize the use of multimedia mitigation programs by the States. The final rule is not expected until late 2002. The potential for legislative activity could further delay or result in changes to the final rule.

Contaminant Candidate List Determinations: EPA continues to review the status of 12 contaminants designated as "regulatory determination priorities" on EPA's Contaminant Candidate List (CCL). Under the 1996 SDWA Amendments, EPA must make regulatory determinations for at least five contaminants. Determinations may be a decision to regulate, not to regulate, or to develop guidance.

EPA has decided to drop three contaminants from consideration due to data gaps: boron, metribuzin, and 1.3-dichloropropene. EPA will recommend guidance for *Acanthamoeba*, sulfate and sodium. EPA is leaning towards regulating aldrin, dieldrin, and metolachlor from the list. EPA is also expected to make regulatory determinations on hexachlorobutadiene, naphthalene, and manganese.

EPA missed the August 2001 SDWA deadline for final determinations, but a notice for proposed determinations is expected in Spring 2002. The regulations for the contaminants from the CCL would be proposed 2 years later and finalized 18 months after the proposal.

Total Coliform Rule Revision and Distribution System Rule: EPA has decided that the TCR will be revised as part of the agency's Six-Year Review process. EPA also intends to expand the rule, or issue a separate rule, on distribution system issues, such as cross-connection control and the need for distribution system management plans. As a first step, EPA is sponsoring the development of a number of white papers on TCR and distribution system issues such as biofilm formation, aging infrastructure, nitrification, decay in water quality, water mains repair, finished water storage facilities, cross-connection control and corrosion, permeation, and leaching. A meeting was held in early March to discuss the technical aspects of distribution system management.

Six-Year Review Determinations: In Spring 2002, EPA plans to publish advanced notices of rulemakings for revised regulations under the Six-Year Review process. EPA is currently conducting technical analyses of existing rules based on a protocol recommended by EPA's National Drinking Water Advisory Council. According to EPA sources, no decisions have been made on whether to revise any existing rule (except for the TCR). However, atrazine and trichloroethylene are likely candidates for revisions. Recently, EPA has indicated that it is looking at fluoride because of implications of how recent studies could affect the Maximum Contaminate Level Goal (MCLG) and chromium (both trivalent and hexavalent chromium) based on the 1998 Integrated Risk Information System (IRIS) risk assessment.

Chlorine Gas Restricted Use: In September 2000, EPA published its intent to classify drinking water and wastewater disinfection applications of chlorine gas as a restricted use classification (RUC) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The consequences of a RUC for chlorine gas would be additional operator training requirements, oversight by delegated State FIFRA primacy agencies and additional labeling requirements.

The Office of Pesticide Programs (OPP) has opened the door for consideration of alternatives other than Restricted Use Classification for chlorine gas. However, OPP is asking for specific information on current or planned training requirements for the water and wastewater industries. AMWA and other water organizations have encouraged EPA to reconsider the proposed approach and are working with OPP on its review effort. There is resistance within the agency to not restrict chlorine gas, because having a non-RUC pesticide application adds complexity to FIFRA implementation and gives the appearance of inconsistency in FIFRA policy administration.

Unregulated Contaminant Monitoring: EPA finalized the Unregulated Contaminant Monitoring Rule (UCMR) in September 1999. The final rule requires all large systems (serving more than 10,000 people) to collect samples for 12 contaminants (List 1) for the first year in a 3-year cycle. Monitoring started in January 2001. In addition to the large systems, EPA randomly selected 800 small systems to participate as well. The rule identifies a total of 36 contaminants to be phased in over a three-tier process (Lists 1, 2, and 3). EPA published the final List 2 rule on January 11, 2001. EPA has had some problems in implementing the UCMR, but seems to have fixed issues with its electronic data reporting system.

Under a direct final rule, published by EPA on March 12, 2002, water systems are required to report monitoring data under the Unregulated Contaminant Monitoring Rule by August 9, 2002. EPA had delayed the reporting deadline because of technical difficulties with the agency's electronic reporting system. The direct final rule will become final unless EPA receives adverse comments by April 11, 2002

6. Review of Wholesale Customer Input

This section summarizes the findings and conclusions regarding the DWSD suburban water supply contracts. This section essentially updates a more detailed 1986 analysis by Black & Veatch on behalf of the DWSD. The following documents have been reviewed:

- DWSD Directive. 98-6, System Expansion Policy
- The 1986 Black & Veatch report
- DWSD's standard template contract for such services
- Three relatively recent contracts or contract amendments (Wixom, West Bloomfield, and Ypsilanti Community Utilities Authority)
- A listing of current suburban water supply contracts that provides 86 separate agreements and their original contract execution and current expiration dates.

An issue that will require further discussion and assessment is exactly how this information will be used over the course of the study.

6.1 Findings and Conclusions

The following findings and conclusions have been reached:

- The DWSD System Expansion Policy is an extension of DWSD's "Growth Policy" adopted by the Board of Water Commissioners in August 1996, which "is for all system growth to be self-supporting." This policy applies to both water and wastewater services. Previously, DWSD provided the needed extensions and improvements to the infrastructure for any expansion in service requested by a customer, spreading these costs among the other existing customers through yearly rate hikes. This new policy requires customers requesting new or expanded service to pay their share of this expanded service, thus creating a "growth pays for growth" system.

  This new policy was created in response to present customer concerns about past policies that seemed to encourage and finance urban sprawl through their paying other customers' growth costs. At the same time, new customers within the DWSD service area expect service if and when their needs dictate. DWSD implemented this policy to ensure fair and economical rates for their customers.

  Under this new growth policy, communities (individually or collectively) may request in writing new or additional services from DWSD that are not prohibited by federal, State, or local regulations. These requests must "determine, recommend, and commit to a specific volume rate requirement for a period of at least ten (10) years." The community (or group) must pay for the actual expansion of the system required to fulfill this request and an entitlement fee to cover the "cost" of the system's loss of peaking capacity. The requesting community or group is also responsible for obtaining the financing necessary to cover these costs.

DWSD sees multiple benefits to this policy. By discouraging urban sprawl, quality of life issues can be enhanced. There is also the opportunity to spread the system's O & M costs over a larger customer base, promoting the "World Class Utility (City)" concept.

- The findings, recommendations, and principles set forth in the Black & Veatch report and adopted by the DWSD represent a sound method of establishing and allocating risks and responsibilities for these types of service agreements.
- New contracts between DWSD and its customers reflect some of the "growth pays for growth" policy. A template contract, representing new DWSD contracts with its customers, includes provisions for term lengths, financing, pressure, and maximum-flow rates of the supply, and for charging these customers for the construction of those pipes and appurtenances necessary to supply this service. The contract provides details on the financial and operational responsibilities and indemnities.

  One of the latest contracts DWSD has signed with a new customer agrees to provide water service to the City of Wixom. This contract, clearly a reflection of the "growth pays for growth" policy, includes provisions to supply water at a maximum flow rate and within a defined pressure range for a period of 20 years. Wixom is charged a fee for the water main DWSD needs to provide the service; this fee is equal to the cost of a water main that could provide the contracted volume of water. If additional capacity is requested within the first 10 years, there will be an additional charge placed on Wixom. DWSD agrees to finance this fee and to finish its supply to Wixom within 30 months of the contract signing.
- It is suggested that DWSD consider incorporating more explicit provisions regarding the maximum amount of water it is required to provide, or for the pricing associated with increases above contractual amounts. The Black & Veatch report does not specifically note whether any of the contracts restrict the maximum annual flow that the DWSD is required to provide. The contracts also obligate DWSD to provide peak hour demand to a particular entity to the extent that it meets peak hour demand in surrounding communities or in the City of Detroit, but appear to be silent on the total volume that may be purchased. Subject to a detailed analysis of the current capacity of the system—supply, treatment, and distribution—communities that exceed their contractual level of demand limit DWSD's ability to extend service to other communities and may expedite the need to expand capacity.

  However, under the current contractual structure, DWSD is not able to directly assess its wholesale customers those additional costs. If warranted by a detailed capacity analysis, it is recommended that DWSD consider adding a surcharge to its contractual water rates for volumes of water that exceed the contractual amounts by some factor. In other areas, such surcharges have been applied for volumes that exceed a minimum 20 percent of the contractual amount.

6.2 Limitations on this Review

This review is limited by the following items:

- Only a few of the 86 contracts have been reviewed. It is assumed that the Black & Veatch report has correctly characterized the provisions of the existing contracts and that no new or modified contracts have been executed that materially differ from the provisions evaluated by Black & Veatch.
- DWSD has apparently executed contract amendments on terms inconsistent with the Black & Veatch's recommendations. Specifically, DWSD has executed contract extensions with an indefinite term despite Black & Veatch's recommendation of a limited term to preserve the DWSD's long-term flexibility. There may be sound reasons for this; however this exception is noted. Similarly, it is assumed that the DWSD has not included provisions contrary to the previous recommendations or not contemplated by the Black & Veatch analysis in any such contract extensions.
- Black & Veatch had identified several examples in which the amount being assessed its buyer was inconsistent with the contract between the Board and the buyer. It has not been determined whether this problem is occurring in additional contracts or whether the problems have been corrected.

7. References

Conceptual Water System Master Plan (August 1997)

Draft Study Report Water Main from 31 Mile Road and GTWRR West to South to Walton Blvd. and Giddings Road Including Romeo Station (January 1998)

Energy Optimization of Water Distribution Systems (September 1994)

Hydraulic Transient Analyses of the Lake Huron Water Transmission System (May 1997)

Interim Report Mobile Research Laboratory Ozonation (DRAFT) (January 1995)

Lead and Copper Corrosion Control Optimization Study (May 1994)

Northern and Western Water Distribution Facility Plan Update (November 1994)

Partnership for Safe Water Self-Assessment Completion Report (September 1998)

Report Study of Water Works Park Plant & Water Transmission System (Vol. 1) (September 1981)

Safe Drinking Water Act Response Program (DRAFT) (June 1995)

Study Report Wixom Water Supply (January 1998)

Water Demand Forecast Report (April, 1997)

Water Quality Model of the DWSD Transmission System (April 1997)

Water Quality in Booster Station Storage Reservoirs: Preliminary Evaluations and Recommendations (INTERIM TECHNICAL MEMORANDUM) (March, 1996)

Water Supply Sanitary Survey (DRAFT) (September, 1995)

DeZuane, J. (1996) *Handbook of Drinking Water Quality*, John Wiley & Sons, Inc., New York, NY.

Journal of the American Water Works Association Regulation Update (March 2000)

Journal of the American Water Works Association (April 2000)

DWSD Directive No. 98-6, System Expansion Policy

Federal Regulations

http://www.epa.gov

The 22 Bioaccumulative Chemicals of Concern (BCCs) in the Final GLI

http://www.nwf.org/greatlakes/gli/analysis/append.html#BCCS

The 29 chemicals with specific water quality criteria set by the Final GLI

http://www.nwf.org/greatlakes/gli/analysis/append.html#LIST

40 CFR Part 132

http://www.epa.gov/docs/epacfr40/chapt-I.info/subch-D/

Brief summary about GLI on the following subjects

Additivity & Costs

http://www.nwf.org/greatlakes/gli/sid/sid-add.html

Chlorine & Ammonia

http://www.nwf.org/greatlakes/gli/sid/sid-chlo.html

Combined Sewer Overflows

http://www.nwf.org/greatlakes/gli/sid/sid-csos.html

Complying (partly) with the Great Lakes Quality Agreement

http://www.nwf.org/greatlakes/gli/sid/sid-wqa.html

Diffuse Sources of Pollution

http://www.nwf.org/greatlakes/gli/sid/sid-diff.html

"Guidance" vs. Regulation Mixing Zone Phase-out for BCCs
http://www.nwf.org/greatlakes/gli/sid/sid-mixz.html

Lake Superior

http://www.nwf.org/greatlakes/gli/sid/sid-ls.html

Pollution Limits Below Level of Detection

http://www.nwf.org/greatlakes/gli/sid/sid-lod.html

Pollution Prevention Opportunities

http://www.nwf.org/greatlakes/gli/sid/sid-pp.html

Risk of Exposure to Great Lakes Toxics

http://www.nwf.org/greatlakes/gli/sid/sid-risk.html

State/Tribal Flexibility

http://www.nwf.org/greatlakes/gli/sid/sid-flex.html

Detroit River area of concern (status assessment)

http://www.ijc.org/boards/annex2/detroit.html

Safe Drinking Water Act 1996 Amendments

http://www.awwa.org/govtaff/advisor/pub_law.htm

Michigan Source Water Assessment Program as Approved by USEPA

http://www.deq.state.mi.us/dwr/SWA/swa.htm