Water Storage Feasibility Study

Charter Township of Commerce

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Appendices

Introduction

In 2008, Giffels-Webster Engineers completed the Commerce Township Water Reliability Study, which included a discussion about water storage. The study recommended that the Township consider constructing a water storage tank with sufficient capacity to control peak hour demands. This could significantly lower the water rates that Commerce Township pays to Detroit Water and Sewer Department (DWSD). Currently, Commerce Township pays DWSD a higher rate for water than any other DWSD customer (see Appendix 1). This is because the rate structure the DWSD has in place depends on several factors including distance from the source, elevation of the receiving community, maximum daily demands, annual volume, and peak hour usage.

The distance and elevation factors are based on Commerce Township's geographical location and these factors cannot be changed. In fact, the peak hour usage factor is the only factor which the Township can reasonably expect to control. If the Township could reduce peak hour demands to be equal to maximum day demands, then Commerce Township could save between $1,300,000 - $1,500,000 in water costs in the first year, with that amount increasing each year as water usage increases.

Peak hour demands typically occur during the morning hours and in the late afternoon during the heat of the summer. This is when people are sprinkling their lawns and at the same time using water for meals and sanitary purposes. To some extent, this peak hour usage can be controlled by changing peoples' behavior and encouraging residents to water their lawns at "off-peak" hours. A few years ago, the Township adopted a water sprinkling ordinance with the intent of changing the residents' pattern of sprinkling their lawns, thus reducing the peak hour usage. So far, this has not been effective.

Another approach to reduce the peak hour is to store water during the times of the day when water demand is low, and then use that stored water when system demand is high. Water can be stored in elevated water storage tanks or in storage tanks that sit at ground level. Water storage tanks do not change the overall peak hour demands of Commerce Township's customers, but rather, the storage tank is used to supplement the water supply coming from the DWSD meters, which lowers the peak hour demand that the DWSD sees at its water meters.

The Oakland County Water Resources Commissioner (WRC) operates & maintains Commerce Township's public water system, and did a preliminary analysis on the installation of water storage in Commerce Township. This analysis estimates potential savings of approximately $1.3 million/year if the Township could reduce peak hour usage. The WRC's preliminary analysis showed that water storage was cost effective and had a return on investment of approximately 5 years.

The Commerce Township Board of Trustees requested that Giffels-Webster Engineers (GWE) expand on the water storage discussions from the Water Reliability Study and the WRC Analysis to provide a more detailed Water Storage Feasibility Study. This report is a summary of the findings from that study. GWE confirms that water storage will be effective at dampening the peak hour demands, which in turn will significantly reduce DWSD's water rates to Commerce Township.

Scope of Study

The purpose of this study was to provide some additional analysis to determine how large the water storage tank should be, whether a booster pump station would be required, possible sites for the tank, and alternative types of tanks along with their associated costs. The following is a summary of steps that were taken to answers these questions:

1) The WaterCAD computer model that was prepared as part of the Water Reliability Study was enhanced to include an extended period simulation (EPS) that simulates the hour by hour demands in the current water system. An EPS model is a more accurate model of the actual system demand throughout an entire time period and can better show whether the system is capable of filling elevated tanks during off peak hours without the use of booster pumps.

2) The WaterCAD model with the EPS simulation was then used to determine the initial requirements for the water storage facility including capacity, elevation, pumping requirements, and the estimated date when additional storage facilities might be required. The model was also used to determine the booster pump requirements.

3) Available maps were used to identify possible locations for the water storage facility. Each location was then photographed and put into a rendering to help the Township board with site selection. (These drawings are not included with the report at this time).

4) Research was done to determine alternative tank designs that are feasible for the proposed use. Pros and cons of each tank alternative were researched as well.

5) Estimates of cost, and return on investment were estimated for the all viable alternatives.

6) Final recommendations were prepared.

It is important to note that water storage tanks are generally designed around three criteria: fire protection, control of peak hour demands, and emergency back-up. The Water Reliability Study concluded that Commerce had a reliable water system capable of meeting fire protection needs without water storage. Thus, in this case, water storage is being considered only to dampen peak hour demands. If the Township wanted to consider providing additional storage for fire protection and emergency back-up, Table 1 below shows the appropriate volumes that would be required.

Storage Use	Volume Needed	Criteria
Fire Proctection	540,000 gallons	3000 gpm over a 3 hour period
Emergency Back-Up	2,000,000 gallons	2,600 gpm (avg day) for the year 2022 over a 12 hour period

Table 1 – Fire Protection & Emergency Back-up Criteria

WaterCAD Model with Extended Period Simulation (EPS)

A steady state WaterCAD model was developed as part of the Water Reliability Study that was completed in 2008. This steady state model used fixed data such as customer demands and water pressures at the DWSD connection points to determine how the water system would respond. The steady state model can be used to evaluate the water system under different fixed rate demands by developing different demand scenarios and running each scenario through the computer model.

In the real world, customer usage is not constant over the course of a day; rather, the demands follow a fairly predictable cycle with peaks in the morning and late afternoon hours, and lower demands in the middle of the day and while people are sleeping. To better understand how water storage will affect Commerce Township's public water supply system, the WaterCAD model was updated to include extended period simulation (EPS). EPS allows the modeler to vary several parameters over the course of time, usually a one to three day period. For this study, only customer demands were considered to be important parameters for modeling with EPS. The supply pressures may also vary over time; but, the pattern of how the supply pressures vary throughout the day is unpredictable. Therefore, the supply pressures for this EPS model were assumed to be the pressures which the DWSD has agreed to provide in the contract.

Extended Period Simulation Assumptions

To develop the EPS model, certain assumptions must be made about customer demand patterns, and about the approach that will be used to lower the peak hour flows to the maximum day demands. For this EPS model, the following assumptions were made:

1) The demand pattern on June 27, 2005 is a typical maximum day demand pattern. This is the day in the year 2005 when DWSD's water system experienced its maximum demand. See Appendix 2 for this demand pattern. This is considered a conservative assumption because as a water system grows, the maximum day and peak hour demands tend to get smaller in comparison to average day demands.

2) Average day demands will increase at a constant rate of 95 gallons per minute per year (based on the Water Reliability Study). This is equivalent to between 400 and 500 residential equivalent units per year and is considered to be aggressive growth. Thus, if the storage facility is sized for 10 years of growth, it may be effective at controlling the peak demands for longer than 10 years based on the actual growth Commerce Township experiences in the same time period.

3) Flow control valves will be installed just down stream of the DWSD meters. Each flow control valve can be set at a desired maximum flow rate. Restricting flow at the DWSD connection points will allow the storage tank(s) to empty during periods when system demands exceed the maximum day demands. The flow control system can be overridden if the storage tank is empty or communication between the tanks and the flow control system is lost.

4) DWSD will continue to allow Commerce Township to exceed the contract maximum day demand without a rate penalty between 12:00 midnight and 6:00 AM. (This is currently allowed per contract).

Extended Period Simulation Scenarios

To evaluate how water storage would affect the Commerce Township water distribution system the following scenarios were developed and analyzed using the WaterCAD model:

1) *Year 2022 Maximum Day Demand (7,800 gpm) with one elevated storage tank*: In this set of scenarios, the model was tested to determine how the system would control peak hour demands with one elevated water storage tank. With this set of scenarios, the model showed:

    a) A storage tank with a volume of 1 million gallons is sufficient to control the peak hour demands for the year 2022 under ideal conditions (950,000 gallons of storage used; 1 million gallons of storage provides less than a 10% contingency). This is less storage than what was estimated in the Water Reliability Study: The EPS model showed that the storage tank was able to refill during mid day lower flow periods, which reduces the amount of storage that would otherwise be required.

    b) The minimum elevation of the tank (tank empty) should be 1088 USGS (or approximately 98 feet high). With this elevation, a minimum static pressure of 35 psi can be maintained throughout the distribution system when the tank is empty. Unit 98 of Huron Hills site condominium has a brick ledge elevation of approximately 1018 USGS, with fixtures on the second floor estimated to be at approximately elevation 1035. This is the highest structure served by the water system, and the water tower will supply over 20 psi of static pressure to the second floor when the tank is empty.

    c) Filling the proposed elevated storage tank during a period of multiple maximum day demands should be possible for several years without the use of a booster pumping station. The EPS model showed that the system is able to fill a 1 million gallon storage tank, at the projected 2022 day demands, with successive maximum day demands.

2) *Ultimate Maximum Day Demand (12,400 gpm):* In this set of scenarios, the model was tested to estimate the volume of storage that will ultimately be required to control the peak hour demands. The system was modeled with storage in the vicinity of Fire Station No. 1. With this set of scenarios, the model showed:

    a) A total storage volume of 1.75 million gallons should be sufficient to control ultimate peak hour demands.

    b) A booster pump station will someday be necessary to fill an elevated storage tank during an extended period of maximum day (or near maximum day) demands, as might be expected when there is a string of hot dry days. The need for a booster station is driven largely by the high water elevation of the elevated tank. Selecting a tank with a lower head elevation (distance from bottom of tank full elevation) will help to put off the need for a booster station.

    c) A booster station that is set up to fill the tank during a six hour period in which the DWSD allows Commerce Township to exceed the maximum day demands is the simplest system and this is the booster system that was modeled. The EPS model showed that working pressures of at least 35 psi could be delivered throughout the system with maximum day demands. An alternative system of booster pump stations, pressure reducing valves, and isolation valves, to create a separate pressure zone could be considered in the future when the booster system will become necessary.

3) *Year 2022 Maximum Day Demand (7,800 gpm) with a ground storage tank.* A ground storage tank is a cylindrical storage tank that has the bottom of the tank sitting near ground level. The volume of the ground storage tank is the same as an elevated tank; however booster pumps are required to move water out of the tank and maintain standard operating pressures on the system. The location and ground elevation of the tank will affect the design criteria for the booster pumps. The pumps will need to have a combined 365 horsepower when discharging into a hydraulic grade line of 1108.

4) *Year 2012 Maximum Day Demand (5,000 gpm):* The EPS models shows that only 420,000 gallons of storage is required to control the peak hour demands for the year 2012.

Locations for Water Storage Tank

There are several locations that could be considered for the water storage tank between Fire Station No. 1 and the Commerce Village area. Some factors that need to be thought out for each possible location are the base elevation and the location of the customer base in regards to the location.

If the Township Board elects to proceed with a water storage tank, then the Board will need to decide on the type of storage tank desired, and a location for the storage tank. This report provides four alternative storage tank designs. It is important for the leaders of Commerce Township to recognize that a water storage tank will be a significant structure and will make a statement to the surrounding area. An elevated storage tank will be seen from far away and can be designed to blend in with the sky or to stand out as a landmark; a ground storage tank will have a lower profile but will still be a significant structure to the immediate neighborhood. This will be a change for the community and it is natural that there will be some concerns from the community.

Alternative Tank Designs

There are several types of storage tanks that can be used in Commerce Township's water system. These are briefly described below:

1) *Spheroid Elevated Storage Tank:* Steel storage tank on a small diameter, steel column as shown in Figures 1a & 1b. Waterspheroids have proven to be the most popular of all single-pedestal elevated water storage tanks. The steel column is larger at the bottom and provides room for equipment/storage while still maintaining a small footprint, and the steel column provides an access-way to the top of the storage tank. Steel spheroid storage tanks have a competitive initial cost, however the cost of maintenance is higher due to larger interior and exterior painted surfaces.

Figure 1a

Figure 1b

2) *Composite Elevated Storage Tank:* Steel storage tank on a larger diameter, concrete column as shown in Figures 2a & 2b. The concrete column provides a significant space for other municipal purposes such as offices or fire station bays, and provides an access-way to the top of the storage tank (a steel cylindrical access way is provided through to the top of the tank). Construction costs for composite storage tanks are similar to the watersperoid; however, the maintenance costs are lower than spheroid tanks because there is less painting required.

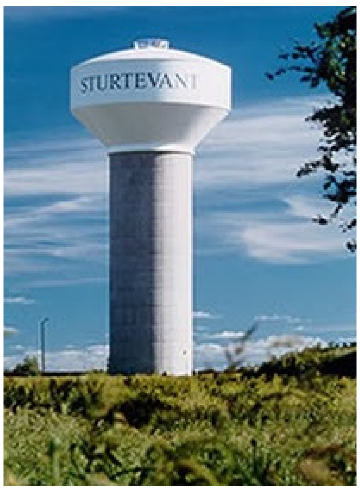


Figure 2a

Figure 2b

3) *Hydropillar Elevated Storage Tank:* Steel storage tank on a large diameter, steel column as shown in Figures 3a & 3b. Like the composite tank, the column provides a significant space for municipal purposes, while providing an access-way to the top of storage tank. This tank is aesthetically pleasing, and can provide a very large volume of storage. However, the maintenance costs are high due to the large amount of steel that needs to be painted.

Figure 3a

Figure 3b

4) *Ground Storage Tank*: The Township may decide that it does not want to have an elevated storage tank for aesthetic reasons. A ground storage tank (as shown in Figures 4a & 4b) is an alternative. A ground storage tank would be constructed of steel or concrete, with a foundation at or near ground level. Initial construction of the tank would be less than an elevated tank; however a booster pump station would be required to pump water out of the tank and into the water system. The disadvantage of ground storage vs. elevated storage is that energy is lost, and needs to be replaced with booster pumps. The result is higher operational costs.

Figure 4a

Figure 4b

Estimated Costs/Return on Investment

The EPS modeling shows that at least 1 million gallons of storage will be required to dampen projected 2022 peak hour demands, and 1.75 million gallons of storage is required to dampen the projected ultimate demands. Table 2 is a summary of construction costs & return on investment analysis for various tank alternatives.

Storage Tank Design	Total Construction Cost (PV)	Yearly O&M Costs	Annual Savings (DWSD)	Return on Investment (Years)
Spheroid				
1.00 MG	$3,379,200	$23,333.33	$1,300,000	2.65
1.25 MG	$3,973,200	$26,666.67	$1,300,000	3.12
1.75 MG	$5,161,200	$33,333.33	$1,300,000	4.07
2.00 MG	$5,755,200	$36,666.67	$1,300,000	4.55
Hydropillar				
1.00 MG	$3,280,200	$30,000.00	$1,300,000	2.58
1.25 MG	$3,857,700	$35,000.00	$1,300,000	3.05
1.75 MG	$5,012,700	$45,000.00	$1,300,000	3.99
2.00 MG	$5,590,200	$50,000.00	$1,300,000	4.47
Composite				
1.00 MG	$3,280,200	$22,000.00	$1,300,000	2.57
1.25 MG	$3,824,700	$25,000.00	$1,300,000	3.00
1.75 MG	$4,913,700	$31,000.00	$1,300,000	3.87
2.00 MG	$5,458,200	$34,000.00	$1,300,000	4.31
Ground				
1.00 MG	$3,248,200	$46,700.00	$1,300,000	2.59
1.25 MG	$3,396,700	$49,250.00	$1,300,000	2.71
1.75 MG	$3,693,700	$54,350.00	$1,300,000	2.96
2.00 MG	$3,842,200	$56,900.00	$1,300,000	3.08

Table 2 – Estimated Costs & Return on Investment

Notes:
All tank cost estimates came from CB&I.
Construction costs include 20% construction contingency and all engineering costs
Annual savings based on estimate from OCWRC for Year 1 – this is conservative

Recommendations

1) Commerce Township should begin the process of designing and constructing a water storage facility. In the fall of 2011, Commerce Township and OCWRC will meet with representatives of the DWSD to establish new rate parameters for the next several years. The Township should have a firm plan and an implementation schedule prior to this meeting.

2) The most important step in moving forward with a water storage facility will be deciding on basic design criteria: site selection, tank design, selecting a look for the exterior of the structure, and considering uses for the interior of the standpipe (elevated tank only). These decisions will be driven by aesthetics along with engineering and land acquisition costs. GWE recommends that the Township form a committee to help with this process.

3) GWE recommends that Commerce Township install a 2 million gallon, elevated storage tank. While the model shows that a 1.75 million gallon tank is sufficient to ultimately control the peak hour demand, the cost difference between a 1.75 and 2 MG tank isn't large (and can be paid back within 5 years or less). This will give the Township extra storage and is the more conservative, safe approach. Additionally, an elevated storage tank is recommended because a ground storage tank will require 365 horsepower of pumps to get the pressures to an acceptable operating pressure. This is not an ideal situation as these pumps will need constant maintenance and electricity. Even in the ultimate scenario, an elevated storage tank will only need a 95 horsepower pump to maintain pressures.

4) Once the design criteria are decided upon, then the design/construction approach should be determined. A design/build approach may be appropriate for this project.

Appendix 1 – DWSD Water Rates

Table 20A
Calculation of Water Rates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Recovery Basis			FY 2011 Rate Schedule	
		Allocated Revenue Requirement	Cct Adjs & Fixed Charges	Net Allo'd Revenue Requirement	Fixed Monthly Charges	Commodity Charges	Volume	Monthly Charge	Commodity Rate
		$	$	$	$	$	(Mcf)	$/month	$/Mcf
1	Allen Park	1,555,177		1,555,177	210,678	1,344,500	140,000	17,556	9.60
2	Ash Township	505,168		505,168	63,327	441,841	44,600	5,277	9.91
3	Auburn Hills	4,050,762		4,050,762	411,260	3,639,503	240,000	34,272	15.16
4	Belleville	246,900		246,900	27,835	219,066	20,000	2,320	10.95
5	Berlin Township	578,842		578,842	67,048	511,794	33,600	5,587	15.23
6	Bloomfield Township	8,356,313		8,356,313	688,325	7,667,988	305,000	57,360	25.14
7	Brownstown Township	2,500,328		2,500,328	294,652	2,205,676	152,300	24,554	14.48
8	Canton Township	8,575,797		8,575,797	866,417	7,709,380	431,500	72,201	17.87
9	Center Line	355,335		355,335	47,540	307,795	41,000	3,962	7.51
10	Chesterfield Township	3,090,510		3,090,510	381,958	2,708,552	200,000	31,830	13.54
11	Clinton Township	5,757,796		5,757,796	787,320	4,970,476	525,000	65,610	9.47
12	Commerce Township	3,763,026		3,763,026	294,053	3,468,973	115,000	24,504	30.16
13	Dearborn	6,701,476		6,701,476	837,015	5,864,461	672,500	69,751	8.72
14	Dearborn Heights	2,532,550		2,532,550	317,645	2,214,905	247,600	26,470	8.95
15	Eastpointe	1,057,424		1,057,424	152,359	905,066	134,800	12,697	6.71
16	Ecorse	1,058,086		1,058,086	148,558	909,529	137,500	12,380	6.61
17	Farmington	761,429		761,429	90,716	670,713	65,000	7,560	10.32
18	Farmington Hills	10,500,139		10,500,139	995,124	9,505,015	515,000	82,927	18.46
19	Ferndale	711,569		711,569	100,360	611,209	80,000	8,363	7.64
20	Flat Rock	953,649		953,649	119,044	834,605	68,000	9,920	12.27
21	Flint	22,189,520		22,189,520	2,187,610	20,001,910	1,400,000	182,301	14.29
22	Fraser	852,001		852,001	106,937	745,064	75,900	8,911	9.82
23	Garden City	1,320,934		1,320,934	153,980	1,166,954	100,000	12,832	11.67
24	Gibraltar	290,736		290,736	36,217	254,519	20,000	3,018	12.73
25	Greater Lapeer C.U.A.	2,057,372		2,057,372	208,714	1,848,658	115,000	17,393	16.08
26	Grosse Ile Township	1,079,491		1,079,491	128,254	951,237	64,500	10,688	14.75
27	Grosse Pt. Park	880,743		880,743	112,906	767,837	67,500	9,409	11.38
28	Grosse Pt. Shores	377,459		377,459	50,110	327,349	22,500	4,176	14.55
29	Grosse Pt. Woods	1,036,055		1,036,055	155,655	880,400	105,000	12,971	8.38
30	Hamtramck	540,849		540,849	80,096	460,754	70,000	6,675	6.58
31	Harper Woods	737,387		737,387	94,703	642,684	65,000	7,892	9.89
32	Harrison Township	1,379,833		1,379,833	170,466	1,209,367	107,500	14,205	11.25
33	Hazel Park	651,196		651,196	87,586	563,610	60,000	7,299	9.39

Table 20A
Calculation of Water Rates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Recovery Basis			FY 2011 Rate Schedule	
		Allocated Revenue Requirement	Cct Adjs & Fixed Charges	Net Allo'd Revenue Requirement	Fixed Monthly Charges	Commodity Charges	Volume	Monthly Charge	Commodity Rate
		$	$	$	$	$	(Mcf)	$/month	$/Mcf
34	Huron Township	1,182,914		1,182,914	137,021	1,045,893	69,400	11,418	15.07
35	Inkster	1,291,363		1,291,363	162,072	1,129,291	127,500	13,506	8.86
36	Keego Harbor	227,501		227,501	21,882	205,619	15,000	1,824	13.71
37	Lenox Twp.	342,119		342,119	37,442	304,677	17,500	3,120	17.41
38	Lincoln Park	2,194,946		2,194,946	285,381	1,909,565	199,000	23,782	9.60
39	Livonia	9,552,074		9,552,074	1,088,496	8,463,578	625,000	90,708	13.54
40	Macomb Township	6,738,274		6,738,274	814,552	5,923,722	410,000	67,879	14.45
41	Madison Heights	1,664,136		1,664,136	222,519	1,441,617	200,000	18,543	7.21
42	Melvindale	459,793		459,793	67,179	392,614	50,000	5,598	7.85
43	New Haven, Vil. of	268,825		268,825	30,199	238,626	15,000	2,517	15.91
44	Northville	509,414		509,414	56,326	453,089	35,000	4,694	12.95
45	Northville Township	4,543,458		4,543,458	408,204	4,135,254	183,000	34,017	22.60
46	Novi	9,266,921		9,266,921	749,082	8,517,839	325,000	62,424	26.21
47	Oak Park	1,104,121		1,104,121	150,377	953,745	140,000	12,531	6.81
48	Oakland Co. Drain Comm.	73,851		73,851	12,155	61,696	10,000	1,013	6.17
49	Orion Twp	3,798,005	(308,729)	3,489,276	303,104	3,186,173	170,000	25,259	18.74
50	Plymouth	673,481		673,481	70,819	602,662	49,500	5,902	12.17
51	Plymouth Township	2,904,209		2,904,209	332,271	2,571,938	165,000	27,689	15.59
52	Pontiac	5,717,273		5,717,273	549,286	5,167,987	405,000	45,774	12.76
53	Redford Township	2,235,523		2,235,523	295,035	1,940,488	210,000	24,586	9.24
54	River Rouge	505,586		505,586	74,793	430,793	65,000	6,233	6.63
55	Riverview	817,437		817,437	101,700	715,738	63,000	8,475	11.36
56	Rochester Hills	11,705,142		11,705,142	997,419	10,707,723	445,000	83,118	24.06
57	Rockwood	226,308		226,308	27,568	198,740	16,000	2,297	12.42
58	Romeo	226,321		226,321	23,938	202,383	12,000	1,995	16.87
59	Romulus	2,895,623		2,895,623	361,144	2,534,480	279,000	30,095	9.08
60	Roseville	1,725,773		1,725,773	235,151	1,490,622	221,100	19,596	6.74
61	Royal Oak Township	175,350		175,350	23,909	151,441	15,000	1,992	10.10
62	S O C W A	13,710,156		13,710,156	1,822,231	11,887,925	1,360,000	151,853	8.74
63	Shelby Township	9,969,298	52,200	10,021,498	994,365	9,027,133	435,000	82,864	20.75
64	South Rockwood	84,491		84,491	10,084	74,407	5,100	840	14.59
65	Southgate	2,006,347		2,006,347	247,301	1,759,047	155,000	20,608	11.35
66	Sterling Heights	10,870,871		10,870,871	1,330,877	9,539,994	750,000	110,906	12.72

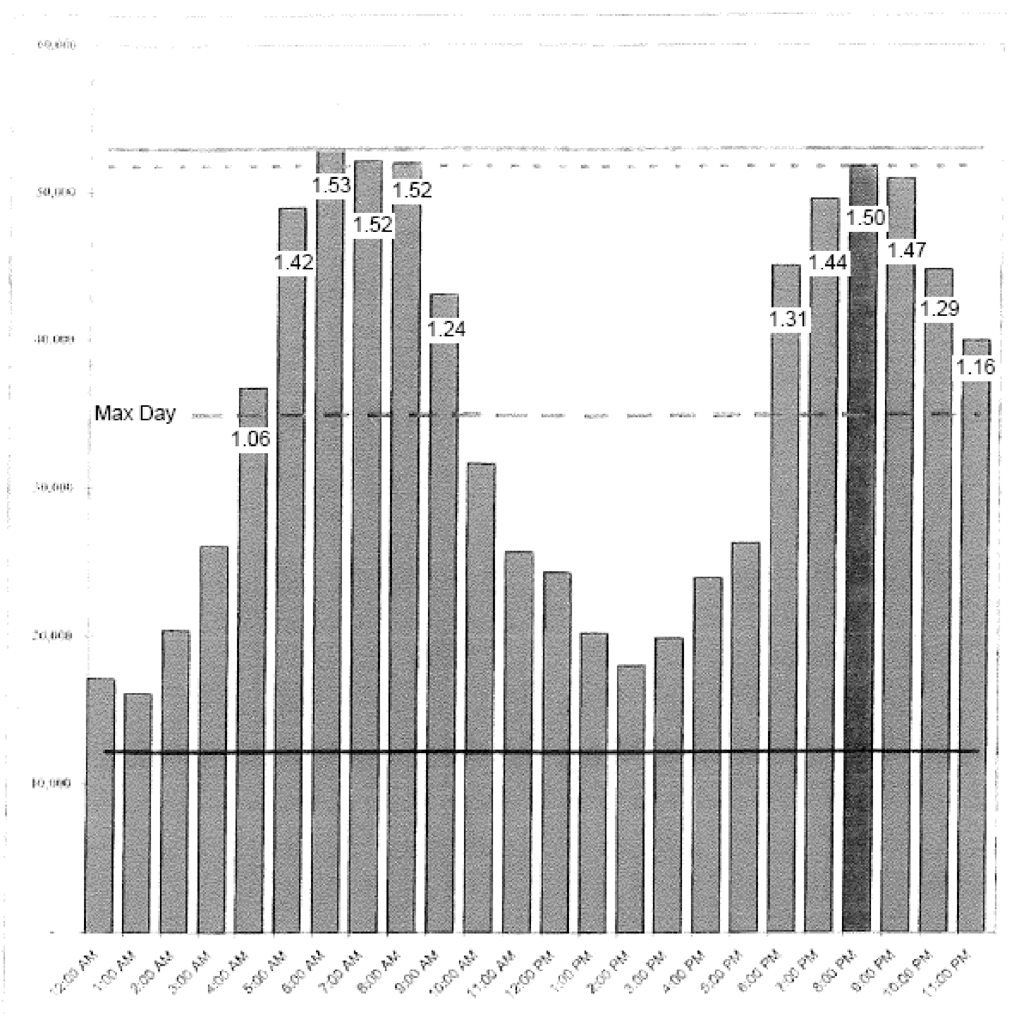
Table 20A
Calculation of Water Rates

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Recovery Basis			FY 2011 Rate Schedule	
		Allocated Revenue Requirement	Cct Adjs & Fixed Charges	Net Allo'd Revenue Requirement	Fixed Monthly Charges	Commodity Charges	Volume	Monthly Charge	Commodity Rate
		$	$	$	$	$	(Mcf)	$/month	$/Mcf
67	St. Clair County-Greenwood	406,794		406,794	374,368	32,426	12,000	31,197	2.70
68	St. Clair County-Burtchville Twp	163,175		163,175	18,737	144,438	7,500	1,561	19.26
69	St. Clair Shores	2,433,007		2,433,007	324,254	2,108,753	297,200	27,021	7.10
70	Sumpter Township	644,334		644,334	68,493	575,841	40,000	5,708	14.40
71	Sylvan Lake	181,124		181,124	16,524	164,600	8,000	1,377	20.58
72	Taylor	3,345,248		3,345,248	441,687	2,903,561	360,000	36,807	8.07
73	Trenton	1,499,366		1,499,366	202,771	1,296,595	117,500	16,898	11.03
74	Troy	8,496,082		8,496,082	940,369	7,555,713	576,000	78,364	13.12
75	Utica	379,387		379,387	43,911	335,477	30,000	3,659	11.18
76	Van Buren Township	1,924,354		1,924,354	248,755	1,675,599	160,000	20,730	10.47
77	Walled Lake	734,093		734,093	63,632	670,461	40,000	5,303	16.76
78	Warren	9,074,656		9,074,656	1,173,708	7,900,948	825,000	97,809	9.58
79	Washington Township	1,917,890		1,917,890	190,115	1,727,775	87,000	15,843	19.86
80	Wayne	1,856,135		1,856,135	253,507	1,602,628	145,000	21,126	11.05
81	West Bloomfield Township	9,667,434		9,667,434	845,620	8,821,814	400,000	70,468	22.05
82	Westland	5,240,822		5,240,822	618,430	4,622,392	395,000	51,536	11.70
83	Woodhaven	1,520,442		1,520,442	174,716	1,345,726	90,000	14,560	14.95
84	Ypsilanti Comm Util Auth	7,501,333		7,501,333	891,797	6,609,536	600,000	74,316	11.02
85	Wixom	1,667,625		1,667,625	168,062	1,499,563	99,500	14,005	15.07

Appendix 2 – 2005 Demand Pattern

Wholesale Customer Flow Profile - Hourly Flows
Summer 2005 Data - DWSD Max Day June 27, 2005

Commerce Township



Hourly Flows

	Average Day	Max Day	Coincident Peak Hour	Non-Coincident Peak Hour
Flow - cf	293,587	838,511	51,806	53,007
Flow per hour - cf	12,233	34,938	51,806	53,007
Increment over Avg Day - cf/hr		22,705	39,574	40,775
Calculated Peaking Factor		2.9	4.2	4.3