
Task B: Planning Criteria

**Comprehensive Water Master Plan
DWSD Contract No. CS-1278**

Final Report

For Submittal to
**Detroit Water and Sewerage
Department**

May 2001



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Executive Summary

This report presents the planning criteria to develop the water demand forecast for the Comprehensive Water Master Plan for the Detroit Water and Sewerage Department (DWSD) through 2050. The defined future study service area for the DWSD includes 246 communities. The demand forecasts include increased service to existing DWSD customers as well as the connection of new customer communities. The planning years are 2000, 2010, 2020, 2030, 2040, and 2050.

The water demand forecast answers the question, “How much water must the water distribution system planner/designer deliver and to where?” To answer this question, basic information about the community, including historical water usage, population trends, planned growth, topography, and existing system capacities must be obtained. For this purpose, the population projections for each community within the defined study service area were studied. Historical water usage and population served were updated to develop per capita demands for the communities with a public water supply system. In addition, rural and urban per capita water demands (PCD) were developed for estimating water demand once the sixty-eight communities currently on private wells decide to join DWSD. The rural and urban PCDs were developed based on a community’s land use characteristics and is 100 and 133 gpcd, respectively. The growth scenario setting the criteria for increasing the service to existing DWSD customers as well as the connection of new customer communities is discussed.

Based on the results of the CWMP population projections, the population of the 246 communities within the DWSD study service area was projected to increase from 5,187,337 in 2000 to 6,235,621 in 2050, an increase of 20 percent (0.4 percent annually) over the next 50 years.

DWSD sells water to 126 customers through individual communities or water authorities (not including the City of Wixom, which will join DWSD in June 2001). They are defined as the Existing DWSD Customers. To determine each individual customer community’s per capita demand for master planning, an update of the average day demand (ADD), industrial/commercial/institutional water use, population served by DWSD water system was performed.

Fifty-two of the 120 non-existing DWSD customer communities, defined as DWSD’s potential customers, have public water supply systems other than DWSD. Their water PCD was revised based on the previous information collected with the DWSD/TYJT Water Questionnaire during 1995 to 1996 (Water Demand Forecast DWSD CS-1171). There were 10 of the 52 that provided more than 5 years’ data. In addition, new information obtained under this CWMP project was used to update the PCD for more than 20 of the remaining 42 communities.

The results of the per capita demands for the total of 174 communities including both existing DWSD customers and other communities supplied by non-DWSD PWSs are

presented in Figure 5-5 and the data are summarized in the “Per Capita Demand Summary” spreadsheet in Appendix G.

A statistical analysis of PCDs obtained showed that the average of the PCD for these 174 communities is 122 gpcd. More than 95 percent of the communities fall within the range of 56 to 189 gpcd (i. e., 2 standard deviations), and 7 were beyond 2 standard deviations. The communities outside 2 standard deviations are Milan, Oxford, Grosse Pointe Farms, Grosse Pointe Shores, Bloomfield Hills, Bloomfield Township, and Farmington Hills. The PCD of Milan, Oxford and Bloomfield Township is 189, 190 and 194 gpcd respectively, only slightly higher than the 2 SD limit. The high PCD of Grosse Pointe Farms, Grosse Pointe Shores and Bloomfield Hills are possibly due to large lots and more landscaping etc. in these communities.

Finally, it should be noted that the projected water demand for the DWSD system for each planning year is not presented in this report, but will be in the Task C “Water Supply & Service Management Plan” report under this CWMP project. The addition of new customers are associated with the proposed/analyzed routes which will be developed in Task C. Therefore, only the guidelines for demand projections using the Adjusted Moderate Growth Scenario are discussed here.

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Abbreviations

ADD	Average Daily Demand
APD	Average Population Density
CWMP	Comprehensive Water Master Plan
CWSMP	Conceptual Water System Master Plan
DWSD	Detroit Water and Sewage Department
DRAM	Disaggregated Residential Allocation Model
EMPAL	Employment Allocation
EMT	Executive Management Team
GCDC	Genesee County Drain Commission
GCPC	Genesee County Planning Commission
GPCD	Gallon Per Capita Per Day
ICI	Industrial, Commercial and Institutional Water Uses
LCPC	Lapeer County Planning Commission
MCD	Minor Civil Division
MG	Million Gallon
MGD	Million Gallon per Day
MGY	Million Gallon per Year
PCD	Per Capita Demand
PWS	Public Water System
RDF	Regional Development Forecast from SEMCOG
SD	Standard Deviation
SEMCOG	Southeast Michigan Council of Governments
SEMCOG RDF	SEMCOG Regional Development Forecast
TAZ	Traffic Analysis Zone
TYJT	Tucker, Young, Jackson and Tull Inc.
USEPA	United States Environmental Protection Agency

1. Introduction

The Detroit Water and Sewerage Department (DWSD) provides treated water to nearly 4,000,000 people across more than 1,000 square miles of southeastern Michigan, pumping more than 230 billion gallons 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 an original water master plan developed in 1959 and updated in 1966. To satisfy its mission, DWSD looks to develop an updated comprehensive water master plan to guide the development of its water system over the next 50 years. The Comprehensive Water Master Plan (CWMP) is to be this new plan.

An early stage of the CWMP, Task B, calls for developing the planning criteria. This includes an update of population projections for 2000 to 2050 and revised water demands and demand projections for updated population and service area. This chapter is a general introduction. Chapter 2 introduces the DWSD’s study service area for the CWMP. The third chapter, “Population Projections,” presents the update of the population projections for all the 246 communities in the DWSD defined study service area. The existing land use information for each community within the seven counties of the Southeast Michigan Council of Governments (SEMCOG) area was updated to 1995, and a future plan for land use determined by municipal master plans is also presented in Chapter 4. Per capita demand (PCD), industrial/commercial/institutional (ICI) water use, total population and population served were updated by using the most recent water consumption and population data as discussed in Chapter 5. The per capita demand for the communities on the private wells also was evaluated. Finally, the growth scenario setting the criteria for increasing the service to existing DWSD customers as well as the connection of new customer communities is discussed in Chapter 6, “Growth Scenario.”

Most of this work used an approach similar to that for the April 1997 Water Demand Forecast (CS-1171). However, several key improvements were made under this task:

1. For population projections, the population forecast provided by SEMCOG was adjusted to account for the difference between previous projections published in April 1996 and the current population estimates (April 2000). For Genesee and Lapeer counties, population projections were developed by incorporating historical data.
2. Land use information was updated using the most recent SEMCOG data (1995).
3. To develop PCD estimates, the most recent available data of water consumption, total population, population served, and ICI water use were used.
4. For future service communities, an adjusted Moderate Growth Scenario, developed in the earlier Water Demand Forecast project, will be adopted. The Adjusted Moderate Growth Scenario considers increasing the service to DWSD customers as well as connecting new customers identified as likely to connect to DWSD. Under this growth scenario, the effect of adding communities supplied by other public water systems but close to a transmission line on the Detroit water system will be evaluated as well.

2. DWSD Defined Study Service Area

In November 1995, a series of work group meetings were held by the Detroit Water and Sewerage Department (DWSD) for the purpose of defining the DWSD's water service area and discussing water demand forecasting. These meetings were conducted by DWSD's Executive Management Team (EMT) with DWSD staff and consultants performing work related to water system planning during that time. Based on the Executive Management Team meetings, the service area for the DWSD water system was defined and is shown in Figure 2-1. This service area includes a total of 246 communities within the 9 counties of southeastern Michigan:

- Genesee County (whole)
- Lapeer County (part)
- Livingston County (part)
- Macomb County (whole)
- Monroe County (part)
- Oakland County (whole)
- St. Clair County (whole)
- Washtenaw County (part)
- Wayne County (whole)

Within the DWSD defined study service area, the communities were further classified into existing and potential DWSD customers for the Comprehensive Water Master Planning project, as presented in Figure 2-1.

Existing DWSD Customers

Existing DWSD customers are communities that are either partially or completely served by the DWSD as of 2000. As shown in Figure 2-1, 126 communities receive DWSD water either directly or through other communities or water authorities. This does not include the City of Wixom, which will join DWSD in June 2001.

Potential DWSD Customers

Potential customers are communities within the DWSD defined study service area but are not DWSD customers as of 2000. All the rest of the 120 non-existing DWSD customer communities are identified as potential DWSD customers.

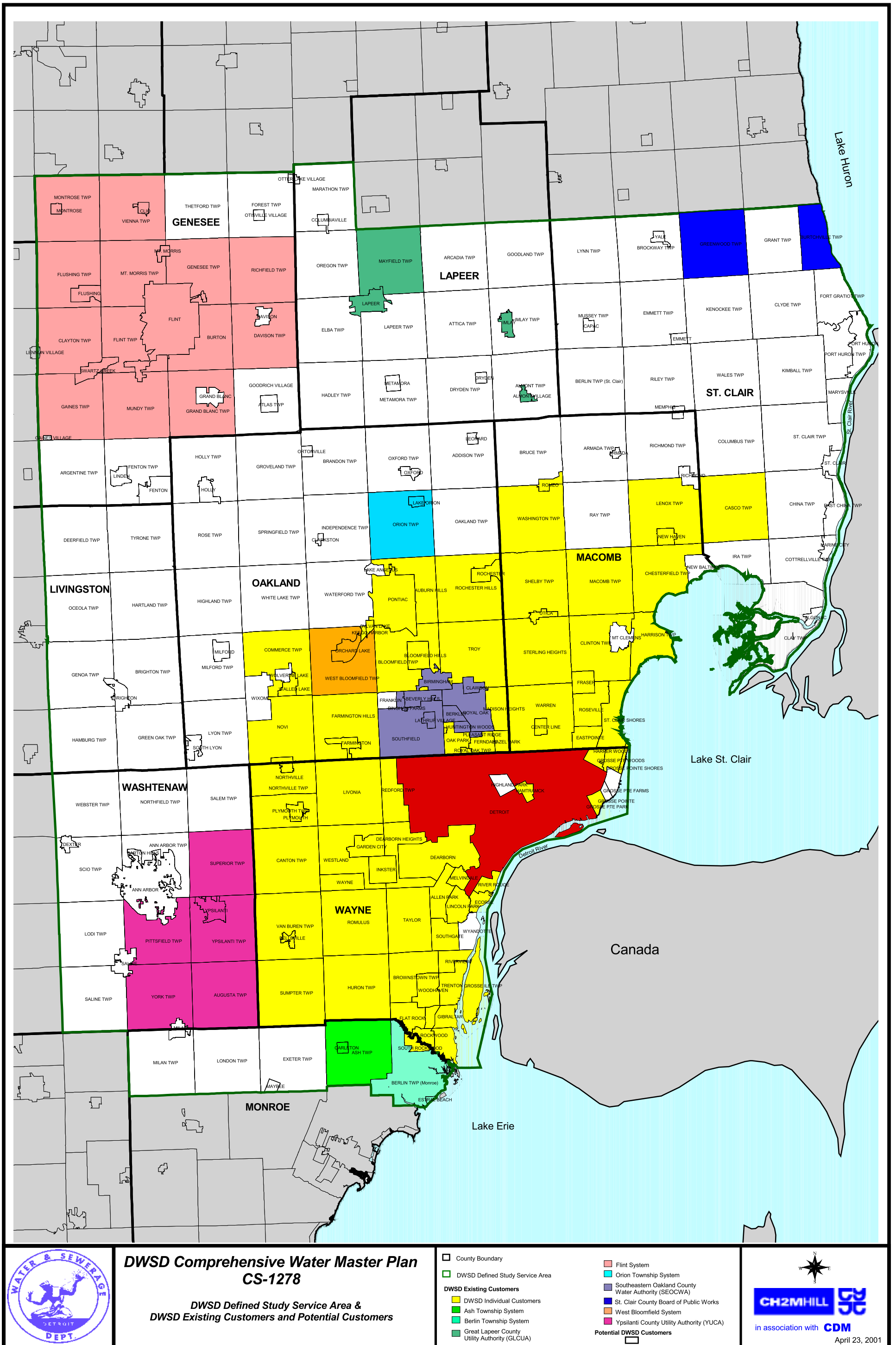


FIGURE 2-1

1) All Communities within the DWSD Defined Study Service Area

2) Existing DWSD Customers as of Year 2000 and Potential DWSD Customers within the DWSD Defined Study Service Area

3. Population Projections

3.1 Introduction

Population projections are fundamental to most planning studies since population is an important measure of water demand for public services. Population projections for communities within the DWSD defined study service area are provided by three separate planning groups: the SEMCOG, Lapeer County Planning Commission (LCPC), and the Genesee County Drain Commission (GCDC). The population projections provided by these planning groups were adjusted to develop population projections for the CWMP. The adjustments were based on additional information collected by the CWMP project team. This chapter describes the background of the data obtained from the planning groups, and the adjustment methods employed to compute population projections for the CWMP. The results of the CWMP population projections are presented at the end of this chapter.

3.2 SEMCOG

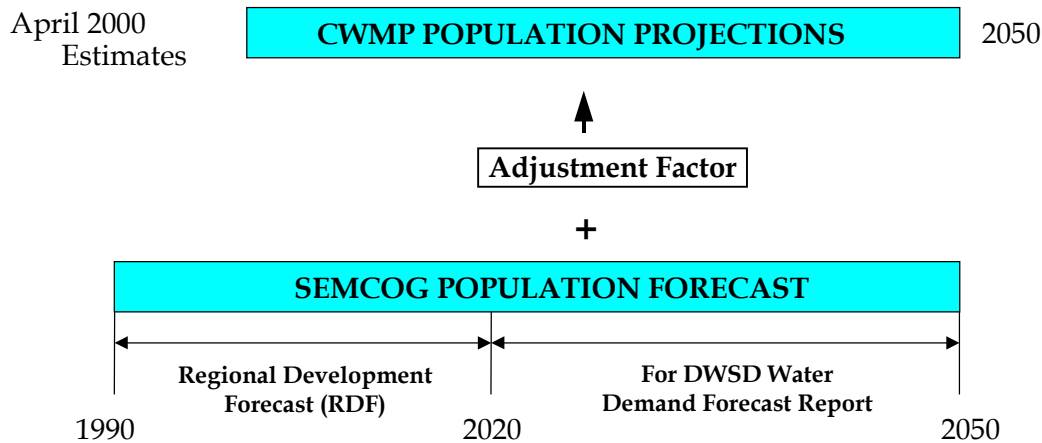
3.2.1 Introduction

SEMCOG is a voluntary association of governmental units in Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne counties. The principal planning activities of SEMCOG include adoption of region-wide plans and policies in the area of transportation, community and economic development, water and air quality and other environmental concerns as well as public safety and land use. SEMCOG also maintains the region's most extensive planning database for demographic, transportation, infrastructure and development. For more than 35 years, it is a depository for U.S. Census data as well as the great volume of data generated in various planning activities.

In April 1996 SEMCOG provided a 2020 Regional Development Forecast (RDF) for the seven county units in southeastern Michigan. Starting with base year 1990 census data, the forecast represents the projected numbers of people, households, and jobs in 5-year intervals through 2020. In 1996, at the request of DWSD, SEMCOG further projected the populations to 2050, the planning year of the DWSD Water Demand Forecast project (CS-1171). For this report, the SEMCOG population forecast is reserved to refer the population projections from the base year of 1990 to 2020 in the SEMCOG 2020 RDF, and the extended projections from 2020 to 2050, as shown in Figure 3-1. Both the RDF forecast and extended forecast for DWSD represents the projected numbers of people in 5-year intervals.

In addition to providing the RDF for a future population projection, SEMCOG also publishes annual population estimates between the census years of 1990 and 2000. These population estimates generally are considered the most accurate and unbiased representation of the actual population, besides the census data. The population estimates are made every July and are made by community, or Minor Civil Division (MCD). Starting in March 2000, the monthly population estimates for each community are available on the SEMCOG website.

FIGURE 3-1
Process of Adjusting SEMCOG Population Forecast for the CWMP



To evaluate SEMCOG’s RDF population forecast, a comparison of the earlier forecast population for 2000 and the current 2000 population estimates was conducted. The differences between the two were minimal, with about 96 percent of the communities being within 15 percent. This showed that the SEMCOG’s RDF population forecast was reasonably accurate at the community level for 2000. However, to take advantage of the most current data, the project team included minor adjustments of the SEMCOG population forecast for the CWMP. The adjustment was made to each MCD by applying an adjustment factor to the SEMCOG forecast. The adjustment factor was the difference between the current population estimates (April 2000; see References) and the SEMCOG 2000 forecast population. The adjustment process is illustrated in Figure 3-1.

The following sections describe:

- SEMCOG population forecast and its methodology
- SEMCOG population estimates and its methodology
- The methodology used to adjust the SEMCOG population forecast for developing population projections for this CWMP (CS 1278)

3.2.2 SEMCOG Population Forecast

3.2.2.1 SEMCOG 2020 Regional Development Forecast

The RDF provided projections for the total region, for cities, villages and townships, as well as for small areas within municipalities. As mentioned earlier, the SEMCOG 2020 Regional Development Forecast (RDF) included the projected numbers of people, households and jobs in 5-year intervals through 2020, starting with base year 1990 census data. These projections were geographically hierarchical: region, county, MCD (community level), traffic analysis zone (TAZ). The borders of the TAZ are defined by major thoroughfares, rivers, and jurisdictional boundaries. Each community (MCD) is comprised of one or more TAZs. The shape files for SEMCOG TAZ and MCD were both obtained and loaded in the CWMP project server. A “Traffic Analysis Zone Map” is included in Appendix A. This map will help to identify the location of each TAZ with respect to its designated community. The total numbers of MCD and TAZ in each SEMCOG County are presented in Table 3-1.

For developing the RDF, three major steps are required for to determine the future growth of the entire southeastern Michigan metropolitan area and then allocate that growth to sub-areas of the region. The first step uses an economic and demographic model to generate Regional Forecast Totals. These set the overall regional growth expectations for population, households and jobs at 5-year intervals from 1990 through 2020. With the context for overall regional growth established, step two is using DRAM/EMPAL (Disaggregated Residential Allocation Model/Employment Allocation) model to produce forecasts for 174 areas called “Forecast Districts” from those Regional Forecast Totals. Thirdly, the district numbers were allocated to 1,442 TAZs. TAZs can in turn be summed to equal cities, villages, townships and counties.

TABLE 3-1
Numbers of SEMCOG MCD and TAZ in Each County

City and County	MCD	TAZ
Detroit City		292
Wayne County	43	334
Oakland County	59	301
Macomb County	27	192
Washtenaw County	28	134
Monroe County	24	71
St. Clair County	32	69
Livingston County	20	49
Total	233	1442

The methodology adopted in the RDF took advantage of established, well-tested computer models used in many large metropolitan areas across the U.S. Small area data from the 1980 and 1990 censuses, the Michigan Employment Security Commission, and other sources through early 1995 were used to represent economic and demographic trends. Data on land development, infrastructure and local plans indicated capacity for future growth.

During the RDF process, SEMCOG had the input and review of a committee of local planners and economic and demographic experts. The community review process included meetings with each of SEMCOG’s seven counties and the City of Detroit in early December 1995. Review comments were used to revise the draft forecast. Following committee review, the completed 2020 Regional Development Forecast was approved and adopted by the SEMCOG Executive Committee on February 23, 1996, and by the General Assembly on March 21, 1996. More details of RDF methodology can be found in SEMCOG’s report, “2020 Regional Development Forecast: Summary Report.”

3.2.2.2 SEMCOG 2020 to 2050 Population Forecast for DWSD

The extended population forecast from 2020 to 2050, specially prepared for the DWSD Water Demand Forecast Project, was developed by using a simplified DRAM/EMPAL model. However, a detailed description of the methodology adopted is not available.

3.2.3 SEMCOG Population Estimates

SEMCOG publishes estimates as a service to its members to meet a growing demand for working household and population numbers under an estimates program, established in the 1970s. The estimates include estimates of population, households and housing units for every city, village and township in Southeast Michigan. Estimates can be used as an effective means of measuring change in a community since the 1990 census. These data enable its members to plan until new census results become available.

Household and population estimates were produced using a standard procedure of housing unit method. The change in the number of housing units was added to the 1990 census housing stock to determine these estimates. New housing additions and demolitions were taken from permits issued by SEMCOG communities for residential buildings and demolitions. The housing unit method provided a very accurate estimate of households. More details of population Estimates methodology can be found in SEMCOG's report of "Population and Households in Southeast Michigan, 1990-2000)."

3.2.4 SEMCOG Population Forecast Adjustment

As noted, based on the difference between the current population estimates (April 2000) and the SEMCOG 2000 forecast, the SEMCOG population forecast from 2000 to 2050 was adjusted to develop the CWMP population projections. This adjustment was made for each TAZ and for each planning year. The methodology of the adjustment is as follows:

1. Calculate the population adjustment factor for each community

$$\text{Population Adjustment Factor} = \text{Year 2000 Population Estimates} - \text{Year 2000 Population Forecast}$$

(This adjustment factor can be updated whenever the census data become available.)

2. Adjust each community's TAZ population projections for each planning year. First distribute the population adjustment factor to each TAZ in the corresponding community using a "weighted" approach. The reason for distributing the adjustment factor was due to SEMCOG population estimates is only available by community not by TAZ (Table 3-2).

Assuming Community A has n TAZs, numbered from 1, ... i, ...n:

$$\text{Population Adjustment Factor for TAZ}_i =$$

$$\frac{\text{Year 2000 Population Forecast for TAZ}_i}{\text{Year 2000 Population Forecast for Community A}} \times \text{Population Adjustment Factor (Step 1)}$$

Second, apply the same TAZ's adjustment factor to each planning year:

$$\text{CWMP Population Projection for TAZ}_i =$$

$$\text{SEMCOG Population Forecast for TAZ}_i + \text{Population Adjustment Factor for TAZ}_i$$

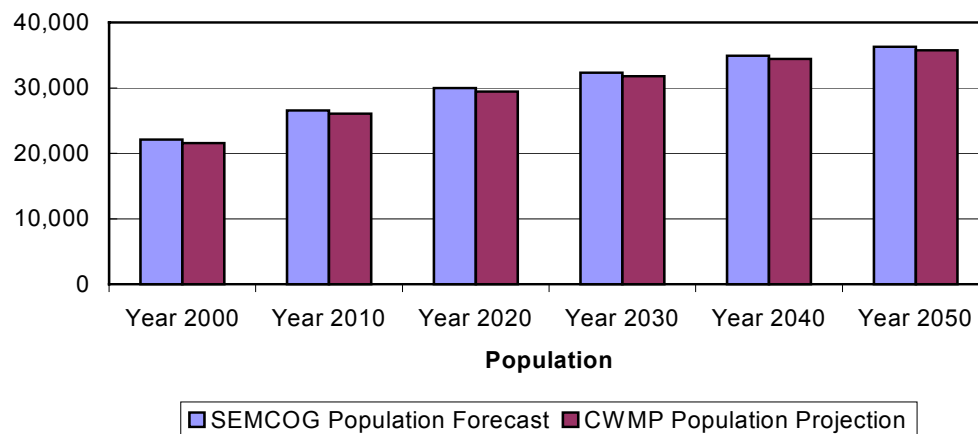
Table 3-2 provides an example of using Northville Township data to illustrate the adjustment made for the CWMP population projections.

Example: Northville Township

TABLE 3-2
Example of Northville Township Population Projection for the CWMP

Northville Township	TAZ No.	Population for Each Planning Year					
		2000	2010	2020	2030	2040	2050
SEMCO G Population Forecast	1980	5761	5655	5584	5553	5521	5517
	1981	4842	5189	5094	5053	5012	5004
	1982	5063	5122	5114	5110	5106	5106
	1984	4812	7353	9148	10518	12183	13097
	1985	1612	3241	5060	6087	7118	7565
	Total	22,090	26,560	30,000	32,321	34,940	36,289
SEMCOG Estimates		21,568					
Population Adjustment Factor	1980	-136	-136	-136	-136	-136	-136
	1981	-114	-114	-114	-114	-114	-114
	1982	-120	-120	-120	-120	-120	-120
	1984	-114	-114	-114	-114	-114	-114
	1985	-38	-38	-38	-38	-38	-38
	Total	-522	-522	-522	-522	-522	-522
CWMP Population Projection	1980	5625	5519	5448	5417	5385	5381
	1981	4728	5075	4980	4939	4898	4890
	1982	4943	5002	4994	4990	4986	4986
	1984	4698	7239	9034	10404	12069	12983
	1985	1574	3203	5022	6049	7080	7527
	Total	21,568	26,038	29,478	31,799	34,418	35,767

FIGURE 3-2
Example of Northville Township Population Projection for the CWMP



3.3 City of Detroit

According to SEMCOG, the current population estimate for the City of Detroit is 965,500 as of December 2000. SEMCOG predicted that the population in Detroit would decrease to 816,074 by 2050. However, during the last decade, the City of Detroit has experienced much new development. Three new casinos were opened as was Comerica Park, the new home of the Detroit Tigers. Ford Field is being built for the Detroit Lions. Compuware headquarters are moving to downtown, and the Campus Martius commercial square is under construction. New loft apartments and subdivisions are being developed in the city area. Detroit has been set as a role model for the renaissance of old cities in the U.S., according to the *Journal of U. S. News*. Thus, the population of Detroit was maintained at 1,000,000 through all the planning years for the CWMP, instead of using SEMCOG's population forecast. The previous SEMCOG forecast was adjusted for each TAZ to a total of 1,000,000 for the City of Detroit. A similar adjustment approach as that used for the SEMCOG communities was followed for Detroit (see Appendix A).

3.4 Lapeer and Genesee Counties

3.4.1 Background

Parts of Lapeer County and all of Genesee County are within the DWSD study service area. Some communities within these two counties are supplied by the DWSD system.

The LCPC previously provided population projections (based on the 1990 census) for 2000 and 2010 and acreage for each community within the county. A copy of the information provided by LCPC was contained in the Water Demand Forecast Report and is presented in Appendix B of this report.

The Genesee County Drain Commission (GCDC) operates and maintains the water and sewer system for 18 communities within the Genesee County area. The GCDC purchases DWSD water from the City of Flint and then sells it to its member communities. The GCDC completed a study of its water system in 1993. Based on the 1990 census, it identified the 1990 and 1993 population for all communities in Genesee County along with the expected populations for 2000 and 2010. A copy of the population and demand projections for Genesee County is in Appendix C of this report.

The population projections received from both the GCDC and LCPC included projections for only 2000 and 2010. According to the footnote of the information submitted by LCPC, its population projections were published prior to the 1990 Census, and there has been no update since then.

3.4.2 Methodology of Developing Population Projections for Lapeer and Genesee Counties

To update the data, the CWMP project team researched more recent information to forecast the population for these two counties. Firstly, the historical data of the 1990 census population, and annual population estimates of July 1990 through July 1998, published by the United States Census Bureau, were found for each community (see References). Secondly, the team met with the planning staff in LCPC and GCDC to discuss their

counties' future development. Combining the historical population data found with the information provided by these two counties, a preliminary population forecast was made by using the method described below. These preliminary population projections were later submitted to Lapeer and Genesee counties for review and comment in November 2000.

3.4.2.1 Lapeer County

The following steps were followed to project the population for the Lapeer County communities:

1. The 1990 population provided by LCPC was compared with the data from the U. S. Census Bureau. If different, the census population from the U. S. Census Bureau was used for 1990.
2. The annual population estimates from 1991 to 1998 from the U. S. Census Bureau were recorded.
3. The populations from Year 1990 to 1998 were then extrapolated to obtain the 2000 population for the CWMP.
4. The LCPC 2010 population projection was adjusted by the difference between the CWMP 2000 population calculated in Step 3 and the LCPC 2000 population projection, as follows:

CWMP Population Projection for 2010 =

LCPC 2010 Projection + (CWMP 2000 Population - LCPC 2000 Projection)

5. The new population data from 1990 to 2010 were extrapolated for 2020, 2030, 2040, and 2050.
6. For communities that showed a declining trend, their populations were maintained constant from 2020 to 2050. The reason for doing this is because a community cannot drop beyond its baseline plus it is a more conservative assumption for our planning purposes.

An example of this procedure for Oregon Township is illustrated below:

Example: Oregon Township

TABLE 3-3
Example of Oregon Township Population Projection for the CWMP

Year	Population	Year	Population	Year	CWMP Population Projection
1990 <i>Census</i>	5,913	1996 <i>Estimates</i>	8,030	2000 ^a	9,471
1991 <i>Estimates</i>	6,111	1997 <i>Estimates</i>	8,433	2010 ^b	10,936
1992 <i>Estimates</i>	6,246	1998 <i>Estimates</i>	8,830	2020 ^c	14,342
1993 <i>Estimates</i>	6,588	LCPC 2000 Projection	7,862	2030 ^c	17,101
1994 <i>Estimates</i>	6,959	LCPC 2010 Projection	9,327	2040 ^c	19,860
1995 <i>Estimates</i>	7,409			2050 ^d	22,619

a. Population for 2000 was extrapolated from 1990 to 1998.

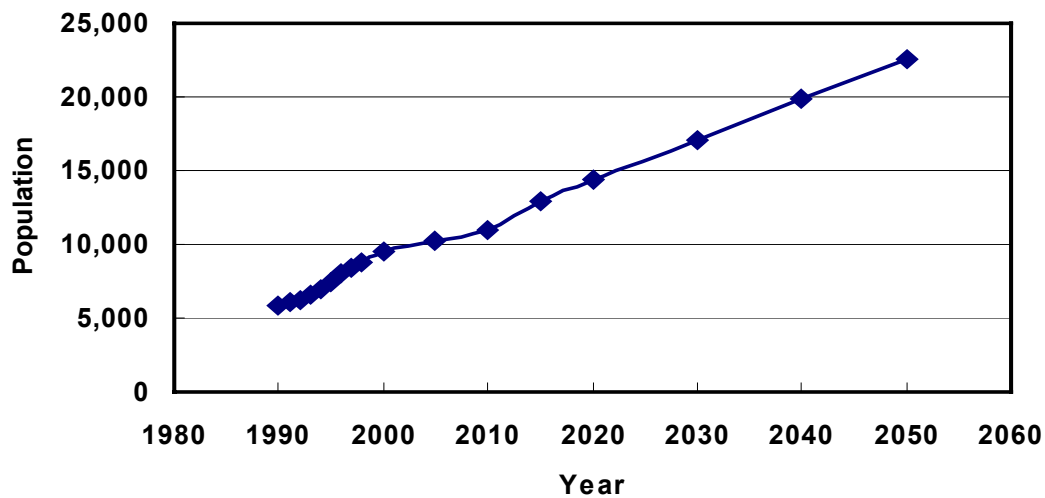
b. CWMP Population Projection for 2010 =

LCPC 2010 Projection + (CWMP 2000 Population – LCPC 2000 Projection)

= 9327 + (9471 – 7862) = 10,936

c. Population estimates for 2020, 2030, 2040 and 2050 were extrapolated, as shown in Figure 3-3.

FIGURE 3-3 Example of Oregon Township Population Projection for the CWMP



3.4.2.2 Genesee County

The population projection for Genesee County was updated by following a similar procedure as described above for Lapeer County:

1. The 1990 population provided by GCDC was compared with the data from the U. S. Census Bureau. If different, the census population from the U. S. Census Bureau was used for 1990.
2. The annual population estimates of 1991 to 1998 from the Census Bureau were recorded.
3. The populations from 1990 to 1998 were extrapolated to obtain the 2000 population for the CWMP.
4. The GCDC 2010 population projection was adjusted to get 2010 CWMP population projection as shown following:

CWMP Population Projection for 2010 =

Adjusted 2010 GCDC Projection + (CWMP 2000 Population – Adjusted GCDC 2000 Projection)

Where, the adjusted 2000 and 2010 GCDC projections were calculated by:

Adjusted 2000 GCDC Projection =

GCDC 2000 Projection + Difference between GCDC 1990 Pop. with 1990 Census Pop. (from step 1)

Adjusted 2010 GCDC Projection =

GCDC 2010 Projection + Difference between GCDC 1990 Pop. with 1990 Census Pop. (from step 1)

5. The new population data from 1990 to 2010 was extrapolated to obtain the population projections for the years of 2020, 2030, 2040, and 2050.
6. For those communities that showed a declining trend, their populations were maintained constant from Year 2020 to 2050 due to the same reason as described earlier.

An example of this procedure for the City of Flint follows:

Example: City of Flint

TABLE 3-4
City of Flint Population Projections for CWMP

Year	Population	Year	Population	Year	CWMP Population Projection
1990 GCDC	142,866	1995 <i>Estimates</i>	135,847	2000 ^b	129,859
1990 <i>Census</i> ^a	140,925	1996 <i>Estimates</i>	134,626	2010 ^c	124,266
1991 <i>Estimates</i>	139,716	1997 <i>Estimates</i>	133,060	2020 ^d	114,119
1992 <i>Estimates</i>	138,675	1998 <i>Estimates</i>	131,668	2030 ^d	114,119
1993 <i>Estimates</i>	137,707	GCDC 2000 <i>Projection</i>	136,611 (original) 134,670 ^(c) (adjusted)	2040 ^d	114,119
1994 <i>Estimates</i>	136,766	GCDC 2010 <i>Projection</i>	131,018 (original) 129,077 ^(c) (adjusted)	2050 ^d	114,119

a. The 1990 census population from U.S. Census Bureau was 140,925. The 1990 population from GCDC was 142,866. There is a difference of 1,941 people. The population from the U.S. Census Bureau was used here as 1990 census population for the City of Flint.

b. CWMP population for 2000 was extrapolated from 1990 to 1998.

c. CWMP population projection for 2010 =

Adjusted 2010 GCDC Projection + (CWMP 2000 Population – Adjusted GCDC 2000 Projection)

= 129077 + (129859 - 134670) = 124,266

Where, the adjusted 2000 and 2010 GCDC population projections were calculated by:

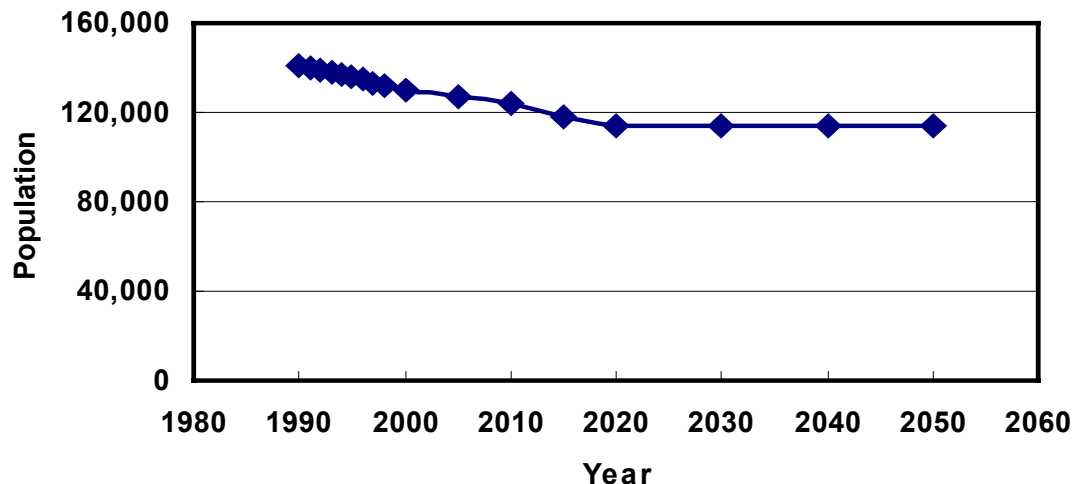
* Adjusted 2000 GCDC Projection = 136611 + (-1941) = 134,670

* Adjusted 2010 GCDC Projection = 131018 + (-1941) = 129,077

d. CWMP population for Year 2020 was extrapolated from 1990 to its previous years.

e. CWMP population projections for 2030, 2040, 2050 were maintained the same as 2020 because the City of Flint showed a declining trend (Figure 3-4).

FIGURE 3-4
Example of City of Flint Population Projection for CWMP



3.5 Summary of Results

Table 3-5 summarizes the expected total population of the whole DWSD defined study service area for each planning year. As shown, the total population of the 246 communities within the DWSD defined study service area was projected to increase from 5,187,337 in 2000 to 6,235,621 in 2050. This is an increase of 20 percent (0.4 percent annually) over the next 50 years. The population growth for each decade, compared with current 2000 population, is presented in Figure 3-5.

The spreadsheet containing the population projections for the SEMCOG area is in Appendix A. These population projections were provided by TAZ and summed by MCD. The population projections for Lapeer County and Genesee County are located in Appendixes B and C, respectively. The projections for the two counties were by community.

TABLE 3-5
Summary of Total Population for the DWSD Defined Study Service Area

	CWMP Population Projections					
	2000	2010	2020	2030	2040	2050
SEMCOG Area	4,672,866	4,878,537	5,102,024	5,274,004	5,426,189	5,628,459
Genesee County	437,411	429,892	434,438	446,716	458,994	471,272
Lapeer County	77,060	86,177	99,689	111,756	123,823	135,890
Totals	5,187,337	5,394,606	5,636,152	5,832,477	6,009,006	6,235,621

3.6 Chapter Summary

SEMCOG, GCDC, and LCPC provided the population projections for the nine counties that encompass the whole study service area defined by DWSD. This chapter describes the background of the population projections obtained from these three planning groups, and the adjustment method we followed to compute the population projections for the CWMP project. Based on the results of the CWMP population projections, the total population of the 246 communities within the DWSD defined study service area was projected to increase from 5,187,337 in 2000 to 6,235,621 in 2050, an increase of 20 percent (0.4 percent annually) over the next 50 years.

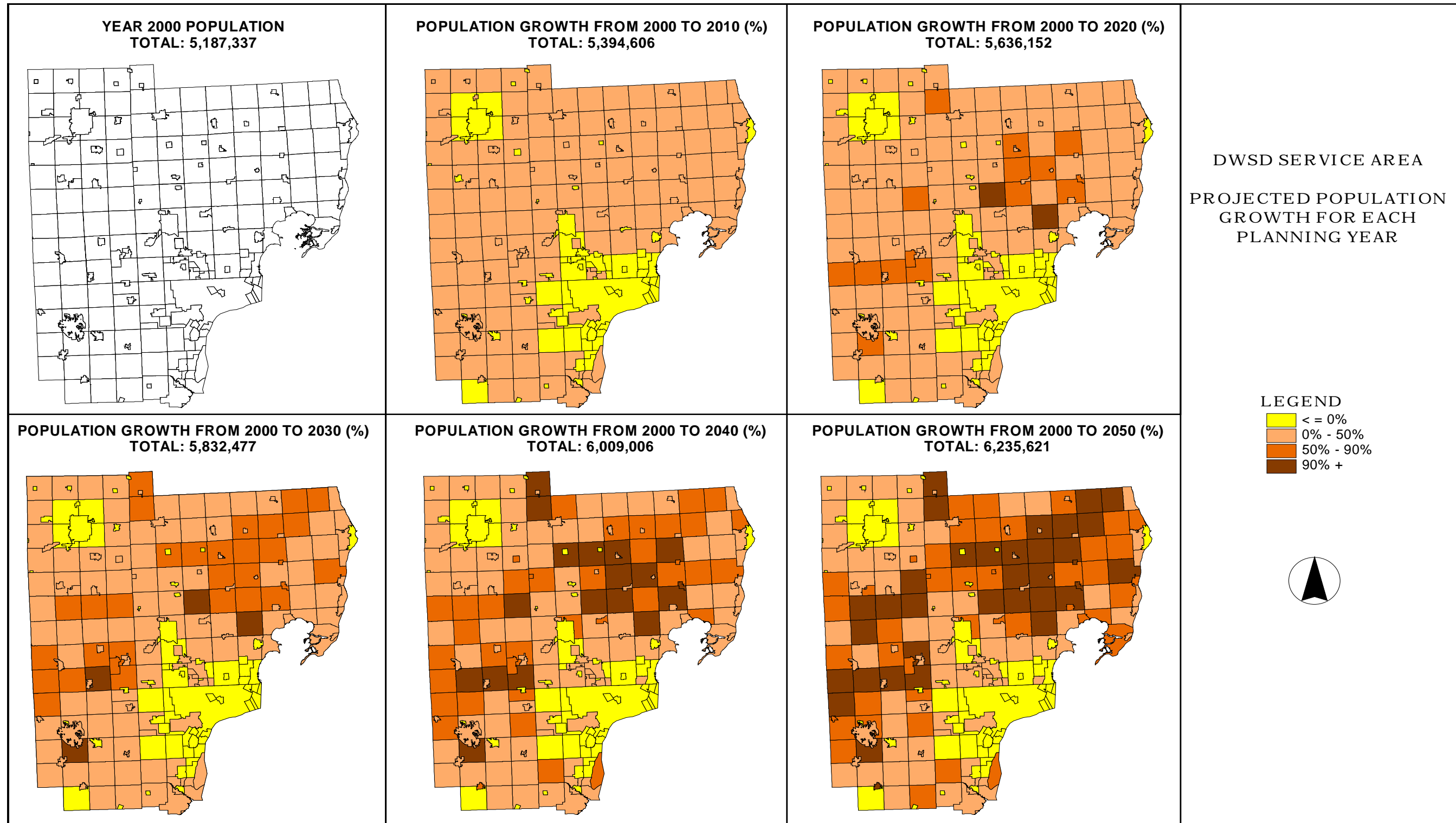


FIGURE 3-5
Projected Population Growth for Each Planning Year

4. Land Use Information

Land use information is a good predictor of how the water use will be distributed within a community. For the Comprehensive Water Master Plan, the land use information was also used as a criterion in defining a community as “rural” or “urban” in order to evaluate the future water use for communities currently on private wells (refer to Chapter 5). In addition, population density was an important criterion in defining the high probability communities that will become DWSD customers in the future (refer to Chapter 6).

4.1 SEMCOG 1995 Existing Land Use

The land use information provided by SEMCOG for the Water Demand Forecast report was from 1990. This information is updated to 1995 here for the Comprehensive Water Master Planning project. The updated information contains total acres and a breakdown of residential, commercial/office, industrial, transportation/communication/utility, institutional, recreation/extractive/barren, cultivated land/brushland, woodland/wetland and water area. The updated 1995 land use data provided by SEMCOG was specially prepared for this CWMP project at the request of DWSD. The data are by TAZ and summed by community in Appendix A. Appendix A also contains a map showing existing land use in 1995.

4.2 SEMCOG Future Land Use

A generalized future land use determined by municipal master plans and zoning ordinance was provided by SEMCOG, and is included in Appendix A of this report.

There is no updated total acreage or breakdown by land use available for Lapeer and Genesee counties.

5. Water Demand

5.1 Introduction

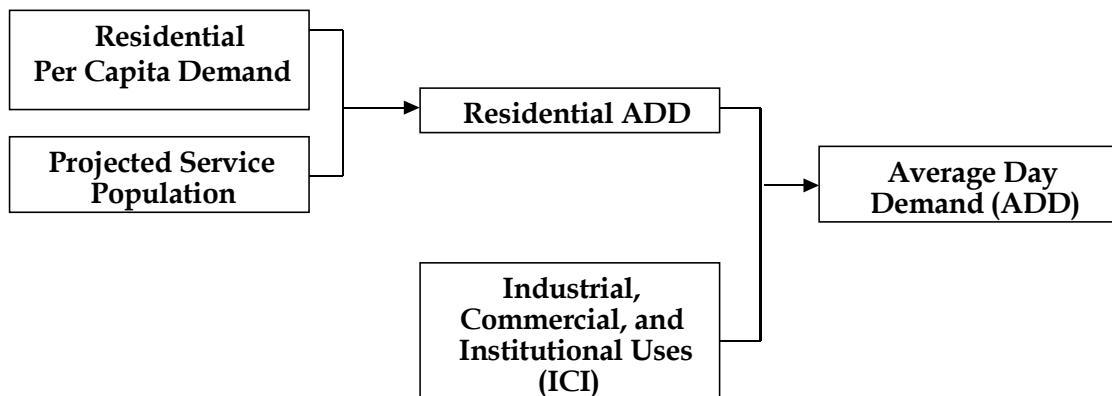
One of the DWSD’s service goals is to provide sufficient water to its customers. Determining future water demand is important for planning the infrastructure needs of the system to meet future service goals. One reliable way to estimate total future water demand is to study each individual community separately because water use varies by geographic location, climate, size of community, extent of industrialization, and other factors unique to that community.

Average day demand (ADD) is a commonly used parameter for measuring water demand. Although maximum day demand and minimum day demand, indications of water consumption changing with the seasons, are important for modeling the hydraulics and water quality in the transmission system, they can be estimated from the ADD by applying peaking coefficients; i.e., ratios to average day demand. More details on this will be discussed in the Task C report under the Comprehensive Water Master Plan project.

The average day demand of a community consists of the residential water demand and industrial, commercial and institutional (ICI) water demand. These two parts are separated because they usually have a different growth pattern in terms of water demand. The growth of the residential water demand mainly depends on the service population and the per capita demand. Service population is the product of total population and corresponding percentage that will be served by DWSD, as discussed in Chapter 2 “Population Projections” and Chapter 6 “Growth Scenario.” Per capita demand typically is estimated from historical water usage. The ICI water use is more dependent on a community’s economic development and its future planning. The components that make up Average Day Demand are illustrated in Figure 5-1.

Previously, in the Water Demand Forecast Report, the per capita demand was developed for each community with historical water consumption data available. Some large ICI water

FIGURE 5-1
Future Water Demand for Each Community



uses were identified in that report as well. However, due to limited information during that time, the PCDs for most communities were developed using 1990 as a base year. Now, new water consumption and population information is available to allow an update of these critical parameters for this planning project.

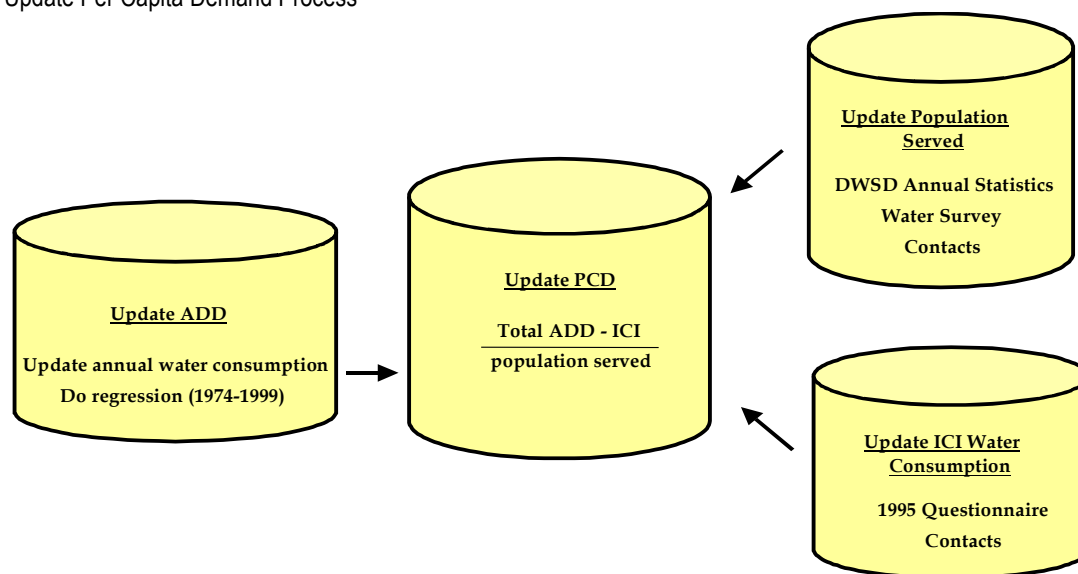
The DWSD Annual Operating Statistics with billing records were collected in order to compute the per capita demand (PCD) for existing DWSD customer communities. The responses from the 1995 TYJT/DWSD questionnaires were used to help determining the PCD of communities served by other PWSs and to verify the consumption of existing DWSD customer communities.

In addition, per capita demands for 68 communities within the DWSD defined study service area, but without an existing public water supply system, were estimated based on the similar communities with public water supply systems. The 68 communities are on private wells, and there is no better way to obtain water consumption data for them.

5.2 Existing DWSD Customers

DWSD sells water to 126 customers through individual communities (Table 5-1) or water authorities (Table 5-2). To determine each individual community's per capita demand for master planning, an update of the average day demand (ADD), ICI water use, population served by DWSD water system was performed. This process is illustrated in Figure 5-2.

FIGURE 5-2
Update Per Capita Demand Process



The following section describes the methodology followed to update the per capita demand for existing DWSD customers.

TABLE 5-1
Existing DWSD Customers

Allen Park	Flat Rock	Melvindale	Shelby Township
Auburn Hills	Fraser	New Haven	South Rockwood
Belleville	Garden City	Northville	Southgate
Bloomfield Hills	Gibraltar	Northville Township	St. Clair Shores
Bloomfield Township	Grosse Ile Township	Novi	Sterling Heights
Brownstown Township	Grosse Pointe Shores	Oak Park	Sumpter Township
Canton Township	Grosse Pointe Park	Oakland County D.C. ^b	Sylvan Lake
Casco Township ^a	Grosse Pointe Woods	Plymouth	Taylor
Center Line	Hamtramck	Plymouth Township	Trenton
Chesterfield Township	Harper Woods	Pontiac	Troy
Clinton Township	Harrison Township	Redford Township	Utica
Commerce Township	Hazel Park	River Rouge	Van Buren Township
Dearborn	Huron Township	Riverview	Walled Lake
Dearborn Heights	Inkster	Rochester ^c	Warren
Detroit	Keego Harbor	Rochester Hills	Washington Township
Eastpointe	Lenox Township	Rockwood	Wayne
Ecorse	Lincoln Park	Romeo ^d (industrial only)	Westland
Farmington	Livonia	Romulus	Woodhaven
Farmington Hills	Macomb Township	Roseville	
Ferndale	Madison Heights	Royal Oak Township	

a. Casco Township receives DWSD water through Lenox Township

b. Oakland County D.C. – Oakland County Drain Commission

c. Rochester receives DWSD water through Shelby Township for small areas. The rest of Rochester is served by its own treated water.

d. Romeo receives DWSD water for Ford Motor Company only through Shelby Township. The rest of Romeo is served by its own treated water.

5.2.1 Average Daily Demand

The annual water consumption collected for existing DWSD customers includes calendar year data for 1974 through 1993 (from the Water Demand Forecast report), plus the additional data for fiscal years 1994 to 1999. The water consumption from calendar year was obtained by summing the monthly total consumption reported in the billing records, whereas the fiscal year data came directly from the DWSD Annual Operating Statistics. The data collected were summarized on a spreadsheets created for each community, referred to as the “Existing Customer” spreadsheet, originally developed for the Water Demand Forecast project and updated by the CWMP project team using all available data as of 2000.

Figure 5-3 shows an example of the “Existing Customer” spreadsheet for Northville Township. The annual demand, in units of 1,000 cubic feet, is shown in the “Actual Consump.” column. The annual demand was then converted into ADD in million gallons per day (MGD), as shown in the “ACTUAL ADD” column.

TABLE 5-2
Existing DWSD Customers by Water Authorities

<p>Ash Township System Ash Township Carleton</p> <p>Berlin Township System Berlin Township (Monroe County) Estral Beach</p> <p>Flint System Burton Clayton Township Clio Davison Township Flint Flint Township Flushing Flushing Township Genesee Township Grand Blanc Township Montrose Montrose Township Mt. Morris Mt. Morris Township Mundy Township Richfield Township Swartz Creek Vienna Township</p> <p>GLCUA (Great Lapeer County Utility Authority) Almont Village Imlay Lapeer Mayfield Township (through Lapeer)</p>	<p>Orion Township System Lake Orion Orion Township</p> <p>SEOCWA (Southeastern Oakland County Water Authority) Berkley Beverly Hills Bingham Farms Birmingham Clawson Huntington Woods Lathrup Village Pleasant Ridge Royal Oak Southfield</p> <p>St. Clair County Board of Public Works) Greenwood Township (Detroit Edison Only) Burtchville Township</p> <p>West Bloomfield System West Bloomfield Township Orchard Lake</p> <p>YCUA (Ypsilanti County Utility Authority) Augusta Township Pittsfield Township Superior Township York Township (part) Ypsilanti Ypsilanti Township</p>
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Once the ADD was computed, a linear regression of the actual ADDs obtained from different years was run to reduce the effects of weather on the average daily demand as illustrated in Figure 5-4. This value is shown in the “PREDICT ADD” column in the Existing Customer spreadsheets. That is to say, by using this regression value, an unusually wet or dry year will not unfairly skew the per capita water demand applied to the community throughout the planning period.

Appendix D contains the “Existing Customer” spreadsheets for individual community DWSD customers. Appendix E contains updated spreadsheets for communities or water authorities that receive DWSD water and subsequently resell to other communities.

The spreadsheets were developed to allow easy updates as new information becomes available in the future. For this reason, blank cells were placed in the “Existing Customer” spreadsheets to allow water demands to be updated for future demand projections.

5.2.2 ICI Water Use

The industrial, commercial, and institutional (ICI) water use data were collected mainly from the 1995 water questionnaire prepared by DWSD and TYJT that was sent to each community. Where communities provided several years of total ICI water use, average consumption was used as long as there were no big changes in the large water users in the recent years (Figure 5-3). The project team also collected updated ICI water consumption data by contacting selected individual community directly. The ICI information is provided either in the “Existing Customer” spreadsheet (Figure 5-3) or in the “Per Capita Demand Summary” spreadsheet (Appendix G). As shown in Appendix G, roughly 27 percent of the 174 communities that have a PCD developed had ICI information available.

5.2.3 Population Served

Several sources of information were used to determine the population served by the DWSD within each community. The original DWSD annual water surveys of 1997, 1998, and 1999, submitted by the community/water authority, served as the primary source of this population served information. The DWSD conducts the water survey annually, and the results are summarized in the DWSD’s Annual Operating Statistics. The second major source of the population served information was the 1995 water questionnaire. If the population served information was not provided in the DWSD water survey or the questionnaire, or the population served number looked abnormal, then that community was contacted directly by the project team.

Two methods were commonly used to estimate the population served based on the information obtained. First, if a community provided a reasonable estimated percentage served by DWSD, then the population served was estimated by:

$$\text{Population Served} = \text{Community Total Population} \times \% \text{ Served by DWSD}$$

Where, the community’s total population = SEMCOG July 1999 Estimated Population for SEMCOG Area (see References), or the U.S. Census Bureau July 1998 Estimated Population for Genesee and Lapeer County Area (see References).

Second, if a community provided service connection numbers, then the population served was estimated by:

$$\text{Population Served} = \text{Community Service Connections} \times \text{Average Household Size}$$

Where, the average household size was provided by SEMCOG for 1990 through 1999

FIGURE 5-3
"Existing Customer" Spreadsheet for Northville Township

Year	Actual Consump. (1,000 ft ³)	Actual ADD (MGD)	Predict ADD (MGD)
1974			
1975	10565.7	0.8685	0.8493
1976	55229.9	1.1350	0.9166
1977	53084.0	1.0909	0.9839
1978	53918.4	1.1111	1.0512
1979	54611.2	1.1223	1.1185
1980	48792.4	1.0000	1.1857
1981	80398.8	1.6477	1.2530
1982	82425.5	1.6893	1.3203
1983	61028.0	1.2507	1.3876
1984	59020.3	1.2063	1.4549
1985	65241.2	1.3371	1.5221
1986	63558.7	1.3026	1.5894
1987	82331.4	1.6873	1.6567
1988	90171.8	1.8430	1.7240
1989	74440.6	1.5256	1.7913
1990	68089.7	1.3955	1.8586
1991	92243.0	1.8905	1.9258
1992	81282.7	1.6613	1.9931
1993	101032.7	2.0706	2.0604
1994	100125.5	2.0520	2.1277
1995	110184.8	2.2582	2.1950
1996	117290.9	2.4038	2.2623
1997	126448.0	2.5915	2.3295
1998	120961.4	2.4791	2.3968
1999	136508.7	2.7977	2.4641
2000			
2001			
2050			

ICI Use

Calendar Year	ICI Uses (gallons)	(MGD)
1988	146,057,628	0.4002
1989	125,919,000	0.3450
1990	128,451,200	0.3519
1991	114,936,000	0.3149
1992	121,099,000	0.3318
1993	136,801,000	0.3748
Average		0.3530

Linear Regression

Slope = 0.0673

Last Regression

Run Date: 05/16/2000

Per Capita Demand

Year	1999
Actual pop.	21146
Pop. served	15244
ADD	2.4641 MGD
Per Cap Demand	162 GPCD
% served	72%

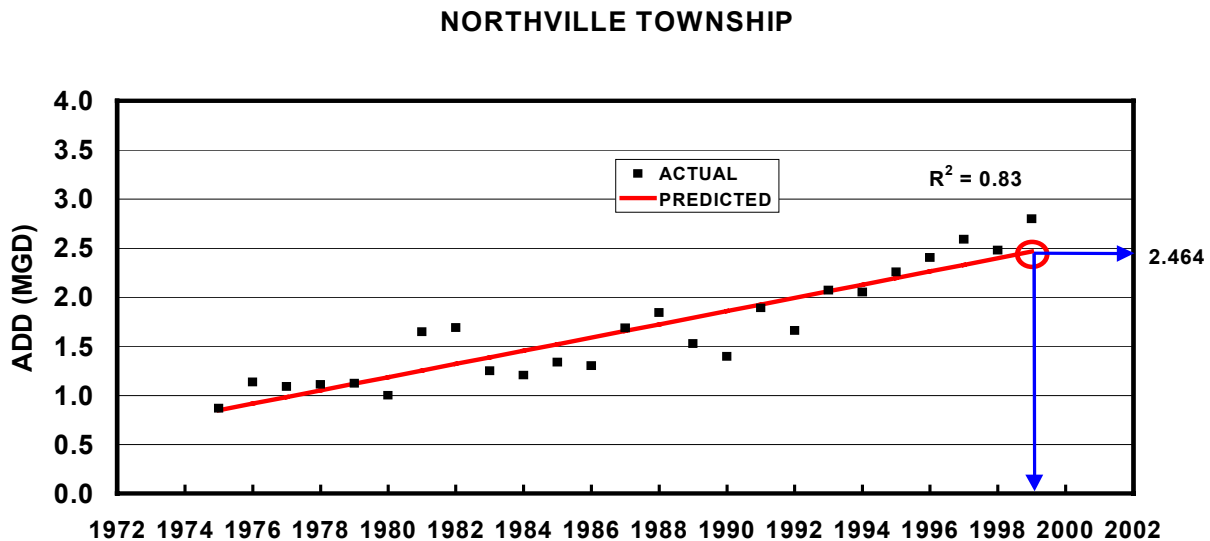
Notes:

To estimate the population served and % served by DWSD in 1999 for Northville Township, historical information from several sources are examined.

1. In the 1995 questionnaire, Northville Township indicated that it was 60–65% served with estimated service population of 12,715. However, the Water Demand Report says, "After reviewing the water section maps, the population served was adjusted to 13,234." The water map reviewed is dated 7/22/93. This increased % served to 76% by using the 1993 population served (13,234) dividing the 1990 total population of Northville Township from the 1990 census. 76% was the number used in the Water Demand Report. However, if using 1993 total population, this would have been 69%.
2. In both the 1998 and 1999 DWSD water surveys, Northville Township indicated that it had a service population of about 13,600 people and the total population was around 20,000 (68%). The service connections were 4,653 in FY 1998 and 4,866 in FY 1999.
3. In the 1997 DWSD water survey, Northville Township indicated that it had a service population of 13,620 people and the total population was 20,336 (67%). The service connections were 4,482 in FY 1997.

The total population increased from 19,136 in 1993 to 21,146 in 1999, or by 2,010. Adding this to the population served number from the Water Demand Report (i.e., assuming all new population is served by DWSD) gives a served population of 15,244, which is used here for PCD calculation.

FIGURE 5-4
Actual ADD versus the Predict (Regression) ADD for Northville Township



However, these methods were not limited in terms of estimating the population served, and the results from utilizing different methods were used as a cross checking for quality control. As shown in Figure 5-3, a comment explaining the estimation number is also provided in the “Existing Customer” spreadsheet for easy understanding or updating by others in the future.

5.2.4 Per Capita Demand

Two per capita demands were developed depending on the availability of ICI information. The overall PCD was calculated by dividing the predicted average daily demand (ADD) by the population served. If there were ICI information available, the residential per capita demand was obtained by subtracting the ICI water uses from ADD. The following two equations illustrate the per capita demand calculations.

$$\text{Overall Per Capita Demand (gpcd)} = \frac{\text{Predicted ADD (mgd)} \times 1,000,000 \text{ gal}}{\text{Population Served} \quad 1 \text{ mg}}$$

$$\text{Residential Per Capita Demand (gpcd)} = \frac{\text{Predicted ADD (mgd)} - \text{ICI (mgd)} \times 1,000,000 \text{ gal}}{\text{Population Served} \quad 1 \text{ mg}}$$

The most recent available data of ADD and population served was used for updating the per capita calculations. For the SEMCOG communities, the 1999 data were used, while 1998 data were used for the communities in Genesee and Lapeer counties.

An example of the Northville Township is presented here to help explain the updating process.

Example: Northville Township

The overall PCD is presented in the “Per Capita Demand” section in “Existing Customer” spreadsheet. The “Per Capita Demand” section indicates the year for which the data were collected, total population within the community, population served by DWSD, and the calculated overall PCD (Figure 5-3).

For customers served directly by the DWSD system, the overall PCD was calculated on the “Existing Customer” spreadsheets (Appendix D). The residential PCD was then calculated on the “Per Capita Demand Summary” spreadsheet. For some water authorities and customers who resell DWSD water to other communities, this residential per capita demand is calculated on the spreadsheets (Appendix E), and then linked to the summary spreadsheet where it is applied to all communities within that authority or group. This difference in approach is the result of having no individual community consumption numbers but having ICI use for some individual customers within the groups.

For individual communities with no ICI information available, the overall PCD will be used for their water demand projection in the future. This should be appropriate because the overall PCD calculated already included the ICI even if it is not identified separately.

5.2.5 Per Capita Demand Summary Spreadsheet

The updated ADD, ICI, total population, population served, percentage served, overall PCD and residential PCD presented in this section were summarized in the “Per Capita Demand Summary” spreadsheet (Appendix G). This spreadsheet also includes the water source and year of which data was used for every existing DWSD customer. The data fields in this summary spreadsheet were linked to the individual community/water authority files of “Existing Customer” spreadsheets in Appendixes D and E, and to the “Communities Served by Non-DWSD Public Water Systems” spreadsheets (Appendix F) to allow automatic updates as corrections are made or new information becomes available.

5.2.6 Comparison of PCD Obtained Using An Alternative Method

As a double check of the PCDs obtained, an alternative method was also examined. The alternative method calculates the residential PCD by using a regression of the community’s actual PCD in last ten years. The results were compared to the current method for twenty-five large communities (i.e. with population > 20,000 and more than 95 percent served by DWSD) as presented in Figure 5-5. As shown in this figure, the differences between the residential PCDs obtained from two methods are very close, all within 16 percent.

TABLE 5-3
Example of ADD, ICI and PCD for Northville Township

1999 Predicted ADD (mgd)	2.4641 ^a
ICI (mgd)	0.3530 ^b
1999 Total Population	21,146
Population Served in 1999	15,244 ^c
Overall PCD (gpcd)	162 ^d
Residential PCD (gpcd)	138 ^e

a. Refer to Figures 5-3 and 5-4.

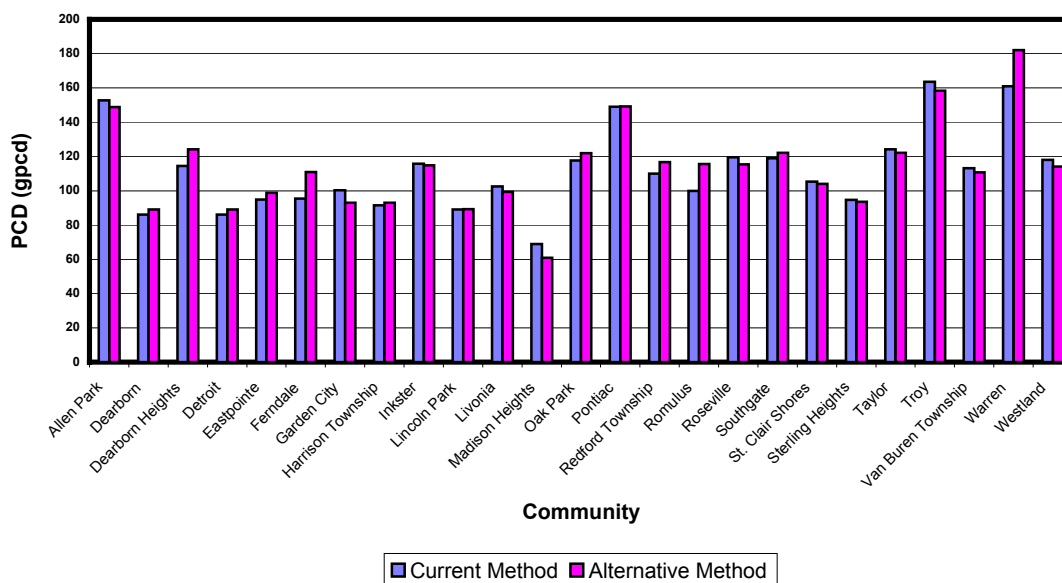
b. ICI is the average of 6 years’ (1988–1993) ICI reported in the 1995 Questionnaire.

c. Refer to Figure 5-3 for the calculation and explanation

d. Overall PCD = $2.4641 \times 1,000,000 / 15,244 = 162$ gpcd

e. Residential PCD = $(2.4641 - 0.3530) * 1,000,000 / 15,244 = 138$ gpcd

FIGURE 5-5
Comparison of Residential PCD Calculated Using an Alternative Method



5.3 Potential DWSD Customers

5.3.1 Communities Served by Non-DWSD Public Water Systems

Within the DWSD service area, 52 communities are served by public water systems other than the DWSD (Table 5-4). These communities fall into two categories: communities that submitted at least 5 years of consumption data in response to the water questionnaire, and communities that submitted less than 5 year of consumption data.

Of the 52 communities served by other PWSs, 10 submitted 5 or more years of consumption data. The per capita demand for the 10 communities was computed in the same manner as that for the existing DWSD customer communities. The spreadsheets for these calculations are located in Appendix F. The 10 communities are listed in Table 5-4.

The per capita demand for the remaining 42 communities was computed based on the limited data provided mostly in the 1995 questionnaires and follow-ups. Previous collected data was reviewed and updated information was obtained to revise the PCDs for more than twenty communities through contacts made by the CWMP project team. Same equations as for the existing DWSD customers were used except the actual ADD was used instead of the regression ADD.

Like for the existing DWSD customers, the water source, updated ADD, ICI, total population, population served, percentage served, overall PCD and residential PCD and the data year for these communities were also summarized in the "Per Capita Demand Summary" spreadsheet (Appendix G).

TABLE 5-4
Communities Served by Non-DWSD PWS

Community	PWS	Community	PWS
Algonac	Algonac	Marine City	Marine City
Clay Township	Algonac	Cottrellville Township	Marine City & Clay Township & Ira Township
Ann Arbor	Ann Arbor	Marysville	Marysville
Ann Arbor Township	Ann Arbor	Memphis	Memphis
Scio Township	Ann Arbor	Metamora	Metamora
<i>Armada</i>	<i>Armada</i>	Milan	Milan
Brighton	Brighton	<i>Milford</i>	<i>Milford</i>
Capac	Capac	<i>Mt Clemens</i>	<i>Mt Clemens</i>
Columbiaville	Columbiaville	New Baltimore	New Baltimore
<i>Davison</i>	<i>Davison</i>	<i>Oxford</i>	<i>Oxford</i>
Dexter	Dexter	Clyde Township	Port Huron
<i>Dryden</i>	<i>Dryden</i>	Fort Gratiot Township	Port Huron
China Township	East China	Kimball Township	Port Huron
East China Township	East China Township	Port Huron	Port Huron
Fenton	Fenton	Port Huron Township	Port Huron
<i>Grand Blanc</i>	<i>Grand Blanc</i>	<i>Richmond</i>	<i>Richmond</i>
Grosse Pointe	Grosse Pointe Frm.	Saline	Saline
Grosse Pointe Farms	Grosse Pointe Frm.	South Lyon	South Lyon
Highland Park	Highland Park	St. Clair	St. Clair
Highland Township	Highland Township	St. Clair Township	St. Clair & Marysville
Holly	Holly	Waterford Township	Waterford Township
Genoa Township	Howell System	White Lake Township	White Lake Township
Oceola Township	Howell System	Wixom *	Wixom
Independence Township	Independence	<i>Wolverine Lake</i>	<i>Wolverine Lake</i>
Ira Township	Ira Township	<i>Wyandotte</i>	<i>Wyandotte</i>
Linden	Linden	Yale	Yale

* Wixom will join DWSD in June 2001

Italic represents the community supplied more than 5 years' data

5.3.2 Communities on Private Wells

There are 68 communities within the DWSD defined study service area are currently on private wells. Historical water use information for these communities is unavailable. However, an estimation of water demand is needed once they decide to join the DWSD

system. For this purpose, two per capita demands, depending on a community's land use characteristics and population density were developed.

The first per capita demand was developed for rural communities. A community was considered rural if it did not meet the Average Population Density (APD) criterion and 50 percent or more of the land is designated as cultivated/brushland or undeveloped land. The APD criterion requires that the APD be equal to or greater than 1.6 people per acre. The population in 2000 and 1995 land use information provided by SEMCOG were used for classifying a community.

The rural per capita demand was developed by taking the average of the per capita demands of the rural communities that are served through PWS/PWSs, and therefore has a PCD available. The per capita demand of 13 rural communities are shown in Table 5-5. The average PCD of these communities is 100 gpcd and is used as the rural per capita demand. It will be applied as the initial PCD for rural communities or for communities that have APD less than 1.6 people/acre, as summarized in the "Communities on Private Wells" spreadsheet (Appendix H).

The other per capita demand developed for private well communities was the urban per capita demand. The urban per capita demand was computed in the same manner as the rural per capita demand, but the land use considered was residential and industrial land rather than cultivated and undeveloped land. Residential land use for SEMCOG designations is comprised of both single family and multiple family dwellings. If 50 percent or more of the land use for a community is designated residential or industrial, the community is considered urban in nature.

The average of the urban communities that have PCD data available is 133 gpcd (Table 5-6). This average is considered as the urban per capita demand and will be applied to the private well/septic communities classified as urban, as presented in Appendix H.

5.4 Quality Check

With the size of the database, which also contains a large amount of information collected from different sources, a quality check is very important. Thus, the project team has developed a quality check procedure for checking all the data used for ADD, ICI and PCD calculations. The quality check procedure is provided in Appendix I.

TABLE 5-5
Rural Per Capita Demand Development

Community	Per Capita Demand (gpcd)
Ann Arbor Township	63
Ash Township	162
Augusta Township	98
Berlin Township (Monroe)	104
Burtchville Township	96
China Township	71
Cottrellville Township	74
Ira Township	169
Lenox Township	95
Scio Township	86
St. Clair Township	109
Superior Township	98
Washington Township	78
Average	100

TABLE 5-6
Urban Per Capita Demand Development

Community Name	Per Capita Demand (gpcd)	Community Name	Per Capita Demand (gpcd)
Algonac	121	Livonia	102
Allen Park	153	Madison Heights	69
Ann Arbor	132	Melvindale	121
Armada	72	Milford	87
Belleville	116	Mt Clemens	179
Berkley	131	Northville	137
Beverly Hills	131	Oak Park	118
Bingham Farms	131	Oxford	190
Birmingham	131	Pleasant Ridge	131
Bloomfield Hills	265	Plymouth	144
Bloomfield Township	194	Plymouth Township	160
Carleton	162	Pontiac	149
Center Line	135	Port Huron	87
Clawson	131	Redford Township	110
Clinton Township	142	River Rouge	174
Dearborn	89	Rochester Hills	171
Dearborn Heights	115	Romeo	99
Detroit	86	Roseville	119
Eastpointe	95	Royal Oak	131
Ecorse	152	Royal Oak Township	83
Estral Beach	104	South Lyon	112
Farmington	144	Southfield	131
Farmington Hills	197	Southgate	119
Ferndale	95	St. Clair	167
Fraser	139	St. Clair Shores	105
Garden City	100	Sterling Heights	95
Grosse Pointe	179	Sylvan Lake	106
Grosse Pointe Shores	209	Taylor	124
Grosse Pointe Farms	257	Trenton	174
Grosse Pointe Park	115	Troy	164
Grosse Pointe Woods	136	Utica	159
Hamtramck	148	Walled Lake	123
Harper Woods	93	Warren	161
Hazel Park	115	Wayne	164
Highland Park	179	West Bloomfield Township	127
Huntington Woods	131	Westland	118
Inkster	116	Wolverine Lake	87
Keego Harbor	180	Wyandotte	100
Lathrup Village	131	Ypsilanti	98
Lincoln Park	89	Average	133

5.5 Summary of Results

The results of the per capita demands for the 174 communities, including both existing DWSD customers and other communities supplied by non-DWSD PWSs, are presented in Figure 5-6 and the data are summarized in the “Per Capita Demand Summary” spreadsheet in Appendix G.

Figure 5-7 shows a statistical analysis of PCDs obtained. It shows that the average of the PCD for 174 communities is 122 gpcd. More than 95 percent of the communities fall within the range of 56 to 189 gpcd (i. e., 2 standard deviations), and 7 were beyond 2 standard deviations. The communities outside 2 standard deviations are Milan, Oxford, Grosse Pointe Farms, Grosse Pointe Shores, Bloomfield Hills, Bloomfield Township, and Farmington Hills. The PCD of Milan, Oxford and Bloomfield Township is 189, 190 and 194 gpcd respectively, only slightly higher than the 2 SD limit. The high PCD of Grosse Pointe Farms, Grosse Pointe Shores and Bloomfield Hills are possibly due to large lots and more landscaping etc. A letter requesting that each community review its PCD calculation was sent to the outliers (except Milan and Oxford). Bloomfield Hills and Farmington Hills confirmed our numbers.

5.6 Chapter Summary

This chapter describes the updating of the per capita demand and ICI water uses for all 174 communities with public water supply systems. This includes existing DWSD customers and communities served by other public water systems. For existing DWSD customers, a spreadsheet was developed for each individual community to list the historical water consumption data and allow using regression analysis to compute per capita demand (Appendix D). A similar approach was used for the non-DWSD public water system communities that provided more than 5 years’ worth of data.

A spreadsheet entitled “Per Capita Demand Summary” was developed to summarize the per capita demand for all 174 communities within the defined DWSD service area and served by a PWS.

In addition, rural and urban per capita demands were developed for estimating the initial water demand for 68 communities that are on private wells. The rural and urban PCDs were developed based on land use information, population density and water use of communities with existing systems (Rural PCD = 100, Urban PCD = 133 gpcd).

PER CAPITA DEMAND (PCD)

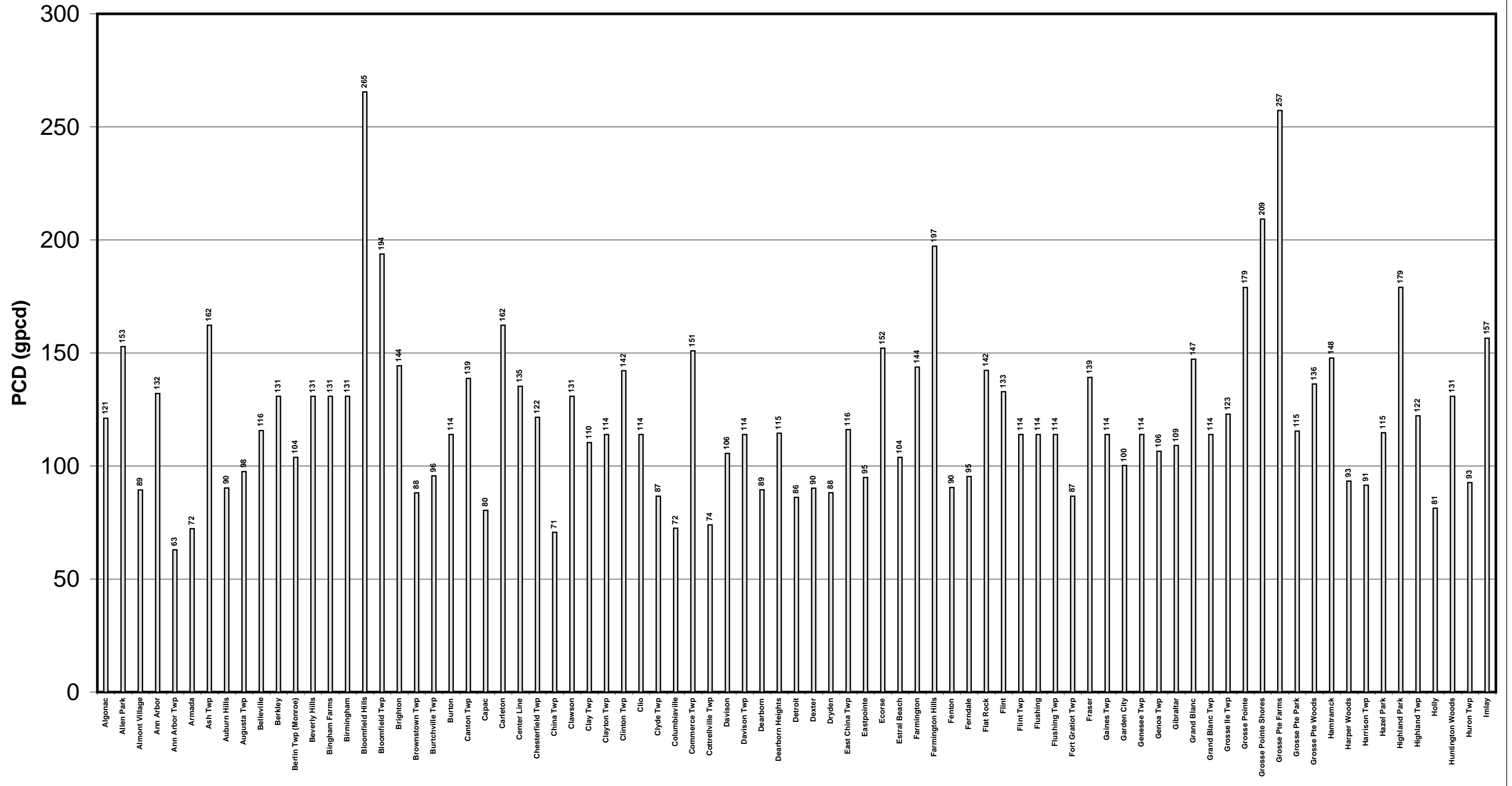


FIGURE 5-6
Summary of Per Capita Demand (1)

PER CAPITA DEMAND (PCD)

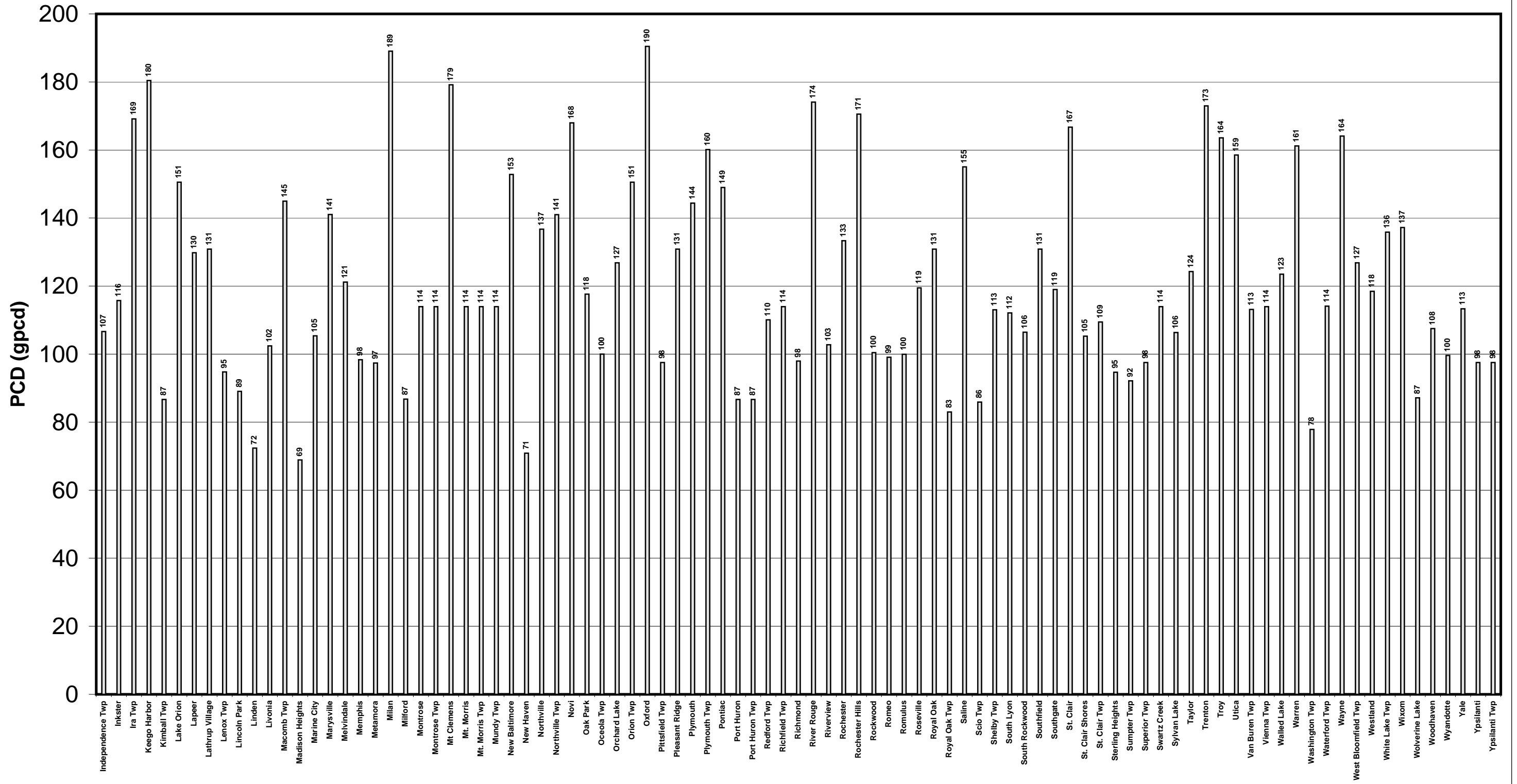


FIGURE 5-6
Summary of Per Capita Demand (2)

6. Growth Scenario

The water master plan spans a period of more than 50 years and includes 246 communities. Accurately predicting water demands over such a long period for hundreds of individual communities is important. This section identified the criteria for selecting the future service customers as well as determining the increase of the percent served for the communities selected in a given planning year.

6.1 Background

In the Water Demand Forecast report, three growth scenarios were analyzed for each planning year. The scenarios were defined as low growth, moderate growth, and high growth.

The Low Growth Scenario represents the lowest projected water demand, in that it assumed that the DWSD system would not grow beyond the customer base identified for service in 2000. Growth in water demand would result only from the increase in service population within the existing communities.

The Moderate Growth Scenario identified all the communities within the service area that have a high probability of connecting to the DWSD transmission system by a given year. (High probability is defined in Section 6.2.2.1.) The Moderate Growth Scenario represents the most probable estimate of which communities will be served in the future. In a combined effort with the DWSD, it was determined that communities located more than 12 miles from a transmission main would not be likely to connect to the DWSD system. This was due to the capital cost involved with a community constructing a new water main to one of the DWSD's transmission mains. The DWSD's planning and engineering staff indicated that it might be difficult to provide water under adequate pressure to a community located more than 12 miles from a transmission main. As a result, the primary criterion used in determining whether a community would be served was whether the community is within 12 miles of an existing or proposed transmission main and not currently served by a PWS. Since most of the townships are about 6 miles across, a "two-township limit" was adopted.

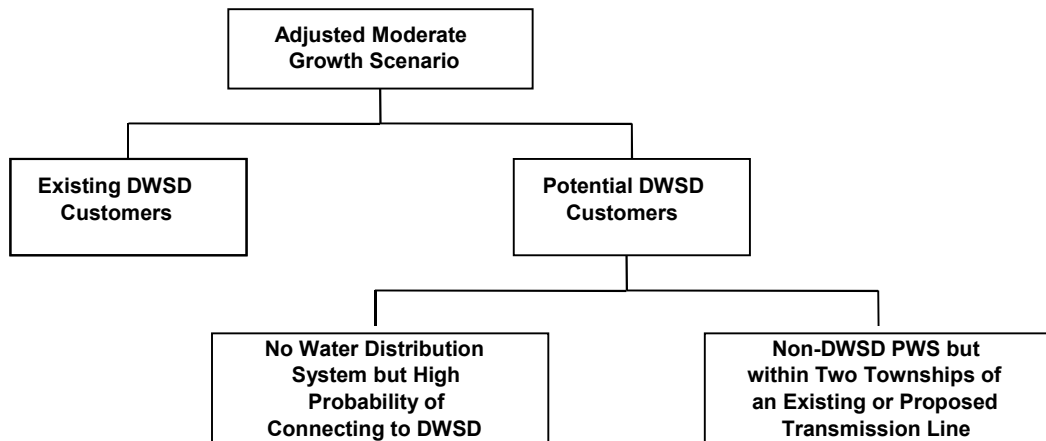
The High Growth Scenario represents the highest projected water demand for the DWSD water system. It included all the communities identified for service in the Moderate Growth Scenario as well as any community served by another PWS that would meet the two-township limit in the future. It was assumed that there would be compelling reasons (regulatory, water quality, water quantity, etc.) in the future for other PWSs to connect with the DWSD system.

6.2 DWSD Service Communities

For the Comprehensive Water Master Plan, an adjusted Moderate Growth Scenario approach is adopted for selecting the future service communities for a given planning year.

The Adjusted Moderate Growth Scenario includes the existing DWSD customers, potential customers with high probability connecting to DWSD system, and evaluate the non-DWSD communities supplied by a public water system but within two townships of an existing or proposed transmission line (Figure 6-1). For planning purposes, this is considered to represent a conservative view of future demands of the growth of the DWSD system.

FIGURE 6-1
Adjusted Moderate Growth Scenario



6.2.1 Existing DWSD Customers

Existing customers are the communities that are either partially or completely served by the DWSD (Tables 5-1 and 5-2). Under the Adjusted Moderate Growth Scenario, all existing DWSD customers as of 2000 will be included for each planning year

6.2.2 Potential DWSD Customers

The potential customers are all the communities within the DWSD defined study service area but not yet a DWSD customer as of Year 2000.

6.2.2.1 Potential Customers on Private Wells

For potential customers with no public water supply systems, high probability DWSD customers will be included in the Adjusted Moderate Growth Scenario. The high probability DWSD customers are potential customers with high probability of connecting to the DWSD transmission system by a given year. High probability communities are communities that meet three or more of the criteria below, with one being the two-township limit:

- Located within 12 miles (two townships) of an existing or proposed transmission main
- Indicated 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 1.6 people per acre
- Identified water quality/quantity concerns

6.2.2.2 Potential Customers with Non-DWSD Public Water Systems

For communities supplied by public water systems other than DWSD, the Adjusted Moderate Growth Scenario will include an assessment of the impact of adding communities that are within two townships of an existing or proposed transmission line. It is assumed that all other communities would continue to be served by the other PWSs and would not be considered in the adjusted moderate growth scenario. In addition to the criteria discussed above, information obtained from individual communities and planning agencies will be considered or used in identifying future customers under this growth scenario.

6.3 Increase of the Percentage Served

To determine the increase in a community's percent served, five community wide classifications are identified. These classifications are listed below.

Existing DWSD Customers

- Type A: DWSD customer 90%–100% served
- Type B: DWSD customer less than 90% served

Non-DWSD PWS

- Type C: Community 90%–100% served by non-DWSD PWS
- Type D: Community less than 90% served by non-DWSD PWS

No PWS (Private Wells)

- Type E: Community served by private wells

Communities classified as Type A were 90 to 100 percent served by the DWSD before 1999.

For these communities, it is assumed that by 2010 the percent served will have increased to 100 percent. Therefore, these communities will be considered completely served throughout the planning study.

Type B communities were communities that were less than 90 percent served by the DWSD before 1999. The increase in percent served for these communities is based on the APD of each TAZ within the community. If the APD of any TAZ meets or exceeds the APD criteria of 1.6 people per acre, the percent served of that particular TAZ would be increased to 100. The percent served value of any TAZ not meeting the APD criteria remains at the same level as the previous planning year. However, it is assumed that, regardless of the APD/TAZ, a community served by the DWSD in 1999 would be completely served at the end of 2020. For communities in which the APD per TAZ remain stagnant or begin decreasing, the percent served value will be increased to 100 percent by increasing the percent served in 25 percent increments per planning year until the percent served reaches 100 percent.

Communities classified as Type C communities were 90 to 100 percent served by another municipality in 1999. Upon connection to the DWSD transmission system, the initial percent served value of a community in this classification will be increased to 100 percent.

Type D communities were less than 90 percent served by another community in 1999. The initial percent served for these communities will be the existing percent served value from 1999. The increase in percent served will be determined using the same approach as that for Type B communities.

Type E consists of communities that use private wells. This group of communities is further broken down into two subgroups. One subgroup consists of communities that meet the APD criteria. If a community meets the APD criteria upon connection to the DWSD transmission system, the initial percent served will be based on the number of TAZs that meet the APD criteria. For every TAZ that meet the APD criteria of 1.6 people per acre, the initial percent served value is set at 100. The other subgroup consists of communities connected to the DWSD system without meeting the APD criteria. The initial percent served for these communities is assumed to be 25. The increase in percent served for all communities in this classification will be determined using the same approach as that for Type B communities.

6.4 Chapter Summary

The water master plan spans a period of more than 50 years and includes 246 communities. Predicting water demands accurately for such a long duration of time and for hundreds of individual communities is important. This section identified the criteria for selecting the future service customers as well as determining the increase of the service for the communities selected in a given planning year for the Comprehensive Water Master Plan.

The Adjusted Moderate Growth Scenario approach is adopted for selecting the future service communities for a given planning year. The Adjusted Moderate Growth Scenario includes existing DWSD customers and potential customers with high probability connecting to DWSD system, and evaluates adding the communities supplied by a non-DWSD public water system but within two townships of an existing or proposed transmission line. For planning purposes, this is considered to represent a conservative view of future demands of the growth of the DWSD system.

In determining the increase in a community's percent served, five community wide classifications are identified and the plans for increasing their percent served are discussed for each of them. The five classifications are:

Existing DWSD Customers (126)

- Type A: DWSD customer 90%–100% served
- Type B: DWSD customer less than 90% served

Non-DWSD PWS (52)

- Type C: Community 90%–100% served by non-DWSD PWS
- Type D: Community less than 90% served by non-DWSD PWS

No PWS (Private Wells) (68)

- Type E: Community served by private wells

The projected water demand for DWSD water system will be presented in Task C “Water Supply & Service Management Plan” under this CWMP project. It will be for each planning year and will show the added new customers based on the guidelines set here under the Adjusted Moderate Growth Scenario.

7. Recommendations

Several recommendations from this study are listed here:

- Due to time limits, in the CWMP population projections, the 2000 SEMCOG estimates were used as the basis for adjusting of the SEMCOG population forecast. As the 2000 census data becomes available, a quality check of the 2000 SEMCOG estimates and SEMCOG forecast by comparing with the census data is recommended. Adjustments are necessary if the discrepancy is significant.
- It is also recommended that as census information becomes available each decade, it should be compared to the projections in Appendixes A, B, and C, and new adjustments should be made as needed.
- During the process of updating PCD, the team found it was difficult and very time consuming to determine the DWSD service percentage for the communities that are not 100 percent served by DWSD based on the information provided in the DWSD annual water survey. It is recommended that DWSD additionally request the source and year of the total population for the annual water survey.
- In the DWSD annual water survey, the water consumption information and location of the large water users (ICI) should be requested.
- The information provided in the DWSD Annual Water Operating Statistics are very helpful for the master planning, therefore, it is important to keep the data as accurate as possible.

8. References

Conceptual Water System Master Plan. August 1997.

Water Demand Forecast Report. April 1997 and November 1997.

Water Quality Model of the DWSD Transmission System. April 1997.

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SEMCOG. April 2000 Population Estimates, in Task B CD under References folder with file name of "April 2000 Estimates by MCD from SEMCOG"

The wastewater discharge books for the Significant Industrial Utility (SIU) from DWSD Industrial Waste Control Center. 2000.

General Correspondences for Task B. (Task B CD under Folder Name: Correspondences).

<http://www.uscensus.gov>

<http://www.semCog.org>

<http://www.mis.org>

Appendix A
SEMCOG Area Population Projections per TAZ
SEMCOG Area Population Projections per
Community
SEMCOG Area 1995 Land Use Data per TAZ
SEMCOG Area 1995 Land Use Data per Community
SEMCOG Area TAZ Map
SEMCOG Area 1995 Land Use Map
SEMCOG Area 1996 Generalized Local Plan Map

Appendix B
Lapeer County Population Projections and Acreage
per Community
Population Projections and Acreage per Community
from LCPC (1995)

Appendix C
Genesee County Population Projections and Acreage
per Community
Population Projections and Acreage per Community
from GCDC and GCPC (1995)

Appendix D
Existing DWSD Customer Spreadsheet

Appendix E
Existing DWSD Customers That Resell DWSD Water

Appendix F
Potential DWSD Customers Served by Non-DWSD
Public Water Systems That Have More Than Five
Years' Consumption Data and Port Huron System

Appendix G
Per Capita Demand Summary

Appendix H
Summary of Communities on Private Wells as of 2000

Appendix I
Quality Check Procedure

