Chapter 11. Sanitary Sewer

Executive Summary

The 1976 Metropolitan Land Planning Act (amended 1995) requires local governments to prepare comprehensive plans and submit them to the Metropolitan Council to determine their consistency with metropolitan system plans. The local comprehensive plan is to include a sewer element covering the collection and disposal of wastewater generated by the community. Similarly, under the Metropolitan Sewer Act, local governments are required to submit a Comprehensive Sewer Policy Plan (CSPP) describing service needs from the Metropolitan Council Environmental Services (MCES). These plans are submitted for MCES approval. The CSPP is broader in scope than the sewer element of the local comprehensive plan and provides detailed sewer system engineering information.

All trunk sanitary sewer construction in Woodbury between 1971 and 1980 was guided by the report entitled "Woodbury Comprehensive Sewer Plan - 1971". This original report was reviewed and updated in 1980 ("Comprehensive Sewer Policy Plan, Woodbury, 1980") and again in 1995 ("Comprehensive Sewer Policy Plan, Woodbury, 1995"). The methods summarized in this report define trunk as all sanitary sewer pipe larger than 12 inches in diameter, all lift station, all force main, and the appurtenant structures and facilities such as manholes, pump houses, generators etc.

The purpose for this report is to update the 1995 report and provide the City with a Comprehensive Sewer Policy Plan that will serve as an inventory of existing facilities and a guide for the expansion of Woodbury's trunk sanitary sewer system to serve its full-development population. The report has been based on the land use and population data as contained in the City's 2000 Land Use Plan.

A layout of the sanitary sewer system including all relevant data is presented on Figure 10 at the back of the report. Preliminary cost estimates have been prepared to establish a basis for updating the Capital Improvement Program and assessment policy. The report has been prepared in accordance with the Metropolitan Council's guidelines for local Comprehensive Sewer Policy Plans.

The report meets both Tier I and Tier II content requirements, as outlined in the Metropolitan Council's Local Planning Handbook (May 1997). Tier I requirements are referenced in Section 2. Tier II requirements are addressed throughout the remainder of the report.

There are seven major sanitary sewer districts in the City, each defining the limits of service for a separate trunk system; or, in some cases, defining the extent of the rural residential land use designation. These districts are further subdivided into sub-districts. These sub-districts were used to develop design flows and to determine cumulative design flows in the various sewer segments. The major sanitary sewer districts, their corresponding prefix abbreviations, and the number of sub-districts in each district are presented in Table 11.1. Figure 10 shows the sub-districts and their relation to existing urban facilities and future sanitary sewer trunk lines.

The 2000 Land Use Plan for the City of Woodbury that served as a basis for the development of the trunk sanitary sewer system is presented in Figure 2. In order to estimate the volume of wastewater flow anticipated, the Land Use Plan was used to divide the City into land use types. These land uses are described in Table 11.3. The estimated acreage for each land use type is listed in Appendix A for every sanitary sewer subdistrict and is summarized in Table 11.2.

The Urban Mixed Residential land use designation covers the majority of future residential development outside the 1999 MUSA boundary. As shown in Table 11.3, the City anticipates that this land will develop at an average density of 3.5 dwelling units per developable acre. This is a general density guideline and actual densities for individual developments might vary significantly. Since the location of these higher density pockets has not been established, it was necessary to provide approximately 25 percent excess sanitary sewer capacity system-wide. The system designed in this manner can serve an estimated population of 125,000 people.

The sewage flows that system oversizing can accommodate are designated "system design flows" and represent an estimate of sewage generated by a full-development population of 125,000 people. The "projected flows" are a percentage of the "system design flows" (approximately 25 percent less), and represent the anticipated sewer flows for Woodbury at a full development population of 100,000 people. The difference between these two flows is the "system reserve capacity." In effect, the system is designed for a larger population to maintain flexibility in applying density requirements to future development.

Sub-district by sub-district, ultimate wastewater flows were calculated by applying unit flow rates to each of the land use categories. The unit wastewater flow rates are presented in Table 11.6.

Table 11.6 gives the unit rates for existing and future residential development. Nonresidential flows are determined on an area basis. The unit flow rates presented in Table 11.6 and used for system design are in accordance with standard engineering practice and are generally considered conservative.

The full-development trunk sanitary sewer system layout for the City of Woodbury is presented on Figure 10 at the back of this report. This map shows major district and sub-district boundaries, existing and proposed trunk sanitary sewers, lift stations, and force mains. In addition, sizes of all sewers are shown with reference points along each pipe. Design flow and existing/proposed capacities for each segment are presented in Appendices 11-3 and 11-4. Present and ultimate capacities for all existing and proposed lift stations can be found in Appendix 11-6.

The proposed alignments of the trunk sanitary sewers are preliminary and should be reviewed at the time of final design to ensure conformance with existing and proposed development. In most cases, the alignments closely follow natural drainage ways. Major changes in alignment are not recommended because these could lead to excessive pipe depths and thus increased construction costs.

One of the basic objectives of this study was to determine the cost of completing the City of Woodbury's trunk sanitary sewer system and, at the same time, to determine new trunk area charges that will ensure availability of sufficient funds for future trunk sewer construction.

The cost estimates presented in this report are based on 1999 construction costs and can be related to the and Engineering News Record (ENR) cost index of 6006 (May, 1999). Future changes in this index are expected to accurately reflect changes in construction costs for the trunk sanitary sewer system proposed in Figure 10.

A summary of the estimated system completion costs appears in Table 11.14. A detailed cost estimate is provided in Appendices 11-5 and 11-6. These costs include all foreseeable expenses associated with the completion of Woodbury's trunk sanitary sewer system, including trunk sanitary sewer, lift stations, and force mains. Land and easement costs are also included. A 10 percent factor for contingencies has been included in the construction cost. The cost estimates also include a 25 percent factor, applied to both land acquisition and pipe construction, which accounts for engineering, administrative, and financing costs. Footnotes in Appendices 11-5 and 11-6 summarize the cost assumptions.

The City of Woodbury Capital Improvement Program is based on the phasing presented in Figure 3 and represents the trunk improvements required to bring service to areas as they open to development. The phasing of trunk elements and their associated costs is presented in Table 11.18. The Capital Improvement Program is intended to serve as a guide for future fiscal planning and should be reviewed annually as more current planning and cost data become available.

11.1 Introduction

The City of Woodbury is located in the eastern portion of the Twin Cities Metropolitan Area, within southern Washington County, as shown on Figure 1. The City is provided excellent transportation service by Interstate 494, Interstate 94, and several county roads.

Woodbury has experienced steady, rapid growth over the past 30 years. The population increased from 3,014 in 1960 to 6,184 in 1970; 10,297 in 1980; and 20,075 in 1990 (U.S Census data). The City is expected to continue its steady growth, with a total population of 48,700 (City of Woodbury projections) anticipated in the year 2000. The City's population grew at an average annual rate of 2,800 people during the 1990 to 1998 period. This annual growth is expected to decrease to about 1,840 people during the 2003 to 2010 period.

Based on current land use planning and the experience of other similarly sized cities, Woodbury's full-development population and the full-development population inside the 1999 Metropolitan Urban Service Area (MUSA) are estimated at approximately 100,000 and 47,000 respectively.

Woodbury's development has followed a west to east pattern over the years, with the most intensive development occurring in the northwest, near the interstate highway corridors. The southern and eastern parts of the City have retained a predominantly rural character, with occurrences of estate residential developments.

Municipal sanitary sewer service was initially provided within the City of Woodbury in 1962 as an emergency measure to alleviate the pollution problems associated with the septic tank systems in the Woodbury Heights area. The first sanitary sewer built in connection with a developing residential area was the Lower Afton Road South Trunk Sewer, which was constructed in 1964.

Cooperative sewer planning began in 1966 when the communities of Woodbury, Oakdale, Northdale, and East Oakdale (W.O.N.E.) formed a joint sewer board and planned an interceptor sewer to serve the developing portions of all four communities. The W.O.N.E. Interceptor sewer was installed in 1968. In 1969, an extension to the W.O.N.E. sewer provided service to the Cardinal development, located south of Tamarack Swamp near Bielenberg Drive. In 1970, the Metropolitan Sewer Board (now the Metropolitan Council Environmental Services) purchased the W.O.N.E. Interceptor along with all of the other interceptor facilities in the Metropolitan Area.

Figure 1 - Location Plan

All trunk sanitary sewer construction in Woodbury between 1971 and 1980 was guided by the report entitled "Woodbury Comprehensive Sewer Plan - 1971". This original report was reviewed and updated in 1980 ("Comprehensive Sewer Policy Plan, Woodbury, 1980") and again in 1995 ("Comprehensive Sewer Policy Plan, Woodbury, 1995"). Trunk sanitary sewer, as a term, is defined in section 3.

The purpose of this report is to update the 1995 report and provide the City with a Comprehensive Sewer Policy Plan that will serve as an inventory of existing facilities and a guide for the expansion of Woodbury's trunk sanitary sewer system to serve its full-development population. The report has been based on the land use and population data as contained in the City's year 2000 Land Use Plan.

A layout of the sanitary sewer system including all relevant data is presented on Figure 10 at the back of the report. Preliminary cost estimates have been prepared to establish a basis for updating the Capital Improvement Program and area charge policy. The report has been prepared in accordance with the Metropolitan Council's guidelines for local Comprehensive Sewer Policy Plans.

The report meets both Tier I and Tier II content requirements, as outlined in the Metropolitan Council's Local Planning Handbook (May 1997). Tier I requirements are referenced in Section 2. Tier II requirements are addressed throughout the remainder of the report.

11.2 Metropolitan Council Tier I Requirements

The Metropolitan Council outlines requirements for comprehensive sewer plans in the May 1997 Local Planning Handbook. Two levels of requirements, defined as Tier I and Tier II, are contained in the handbook. Tier I requirements apply to the sewer element of all communities' comprehensive plans, as required by the Metropolitan Land Planning Act (Minn. Stat. Sec. 473.859, Subd. 3 [2]). Tier II requirements apply to communities that plan to alter, expand, or improve their sewer system. Tier II requirements must be submitted to and approved by the Metropolitan Council before any sewer additions or alterations can be initiated (Minn. Stat. Sec. 473.513).

For this report, both Tier I and Tier II requirements are addressed. The detailed design data required for Tier II is contained throughout the report. The less technical Tier I requirements are also contained in the report, but are referenced below to simplify the review process.

1. Forecasts of households and employment are presented in Tables 11.4 and 11.5.

2. Staging of the sanitary sewer system is presented in Figure 3 and Table 11.18.

3. Projected flows are presented in Tables 11.8 and 11.9.

4. The land use plan is shown in Figure 2.

5. Goals, policies, and strategies for preventing or reducing infiltration and inflow (I/I) in the sewer system are presented in the infiltration/inflow section (Section 7).

11.3 Scope of Study

The 1976 Metropolitan Land Planning Act (amended 1995) requires local governments to prepare comprehensive plans and submit them to the Metropolitan Council to determine their consistency with metropolitan system plans. The local comprehensive plan is to include a sewer element covering the collection and disposal of wastewater generated by the community. Similarly, under the Metropolitan Sewer Act, local governments are required to submit a Comprehensive Sewer Policy Plan (CSPP) describing service needs from the Metropolitan Council Environmental Services MCES). These plans are submitted for MCES approval. The CSPP is broader in scope than the sewer element of the local comprehensive plan and provides detailed sewer system engineering information.

Treatment and disposal of wastewater generated by the City of Woodbury is presently accomplished by the MCES at the Metropolitan Wastewater Treatment Plant. This plant provides permanent service for flows generated in the western part of Woodbury and interim service for the central and eastern and parts of Woodbury. Once Metropolitan Council's South Washington County Interceptor (SWCI) is constructed, the central ("C" sub-districts) and eastern ("VB" sub-districts) parts of the City will, as they develop, have their wastewater conveyed by the new interceptor to the Cottage Grove treatment plant. Woodbury's CSPP details the municipal conveyance facilities required to collect wastewater and transport it to the MCES interceptor system, and does not specifically address the elements that constitute the MCES system.

The local elements of conveyance are the sewer services, laterals, trunks, manholes, lift stations and generators, force mains, and any other facilities required to collect and transport wastewater. As land develops, the location and alignment of sewer laterals and service lines, as opposed to trunk lines and interceptors, are dictated by platting. Prior to platting, those facilities cannot be accurately sized and located, and thus must be excluded from the CSPP. Trunk sewers, however, are largely dependent on topography, soil conditions, physical features and manmade barriers, and can be adequately addressed in the context of a CSPP.

This study is concerned with the trunk system, which includes all sanitary sewer pipes 12 inches in diameter and larger and other facilities (such as lift stations and force mains) that are a vital part of the trunk sewer system. Since the trunk sewer design determines the ultimate service area for the system, it is essential that an overall trunk plan be available as a guide for future development. Such a plan should be flexible enough to absorb some changes in planning and development patterns. Since planning goals may change, periodic review and update of facilities and costs is required.

An outline of the steps involved in preparing the report is presented below:

1. Determine drainage district boundaries for trunk sewers.

2. Relate probable land use to wastewater design flows.

3. Establish preliminary trunk sewer alignment and sizes.

4. Review adequacy of existing facilities.

5. Investigate alternatives for areas where service feasibility or economy is suspect.

6. Examine the City's short and long term sewer needs and develop an orderly phasing plan.

7. Estimate the approximate cost of trunk facilities in order to develop a sound, equitable financing program.

11.4 Topography

Woodbury is bounded on the north by the communities of Oakdale, Landfall, and Lake Elmo; on the east by Afton; on the south by Cottage Grove; and on the west by Newport and Maplewood. Currently, the majority of Woodbury's residents live north of Bailey Road and west of County Road 19 (Woodbury Drive). Generally, the 1999 Metropolitan Urban Service Area (MUSA) has an eastern limit along a line one half section east of County Road 19 and a southern limit of Bailey Road.

The terrain of Woodbury is rolling and consists of steep, short slopes and numerous depressions in the west, with the slopes becoming longer and more gradual and the depressions less frequent toward the east. Lakes and wetlands lie in the bottom of many of these depressions. The prominent water bodies in Woodbury include Battle Creek Lake, Tamarack Swamp, Carver Lake, La Lake and Ria Lake in the western drainage area, which are tributary to the Mississippi River, and Markgrafs Lake, Powers Lake, Wilmes Lake, Colby Lake, and Bailey Lake in the central drainage area, which are tributary to the Cottage Grove Ravine. The Valley Branch drainage in the eastern part of the City is tributary to Lake St. Croix and does not have any prominent water bodies.

11.5 Sanitary Sewer Districts

There are seven major sanitary sewer districts in the City, each defining the limits of service for a separate trunk system; or, in some cases, defining the extent of the rural residential land use designation. These districts are further subdivided into smaller sub-districts that were used to develop design flows and to determine cumulative design flows in the various sewer segments. The major sanitary sewer districts, their corresponding prefix abbreviations, and the number of sub-districts in each major district are presented in Table 11.1.

Table 11.1 - Sanitary Sewer Districts

Sewer District	Abbreviation	No. of Subdistricts
Central	C	58
Valley Branch	V	7
W.O.N.E.	W	14
Lower Afton	LA	1
Carver Lake	CL	10
Newport	--	--
Cottage Grove	CG	3

The boundaries of all the major and minor districts are shown on Figure 10 at the back of this report. Recent development and currently proposed phasing have prompted revisions to the sub-district boundaries over those shown in previous reports, though the major district boundaries remain essentially the same. The Newport District and the Cottage Grove District are designated rural residential and have not been included in the trunk system analysis. A summary of the areas and the existing and anticipated residential units in each major district and sub-district is presented in Appendix 11-1.

11.6 Land Use and Population

General

The sizing of sanitary sewer facilities is dependent on the hydraulic capacity required for each part of the system. Municipal wastewater is generally a mixture of domestic sewage, commercial and industrial wastes, ground water infiltration and surface water inflow. With proper design and construction, ground water infiltration is reduced to a minor percentage of the total flow and surface water inflow is eliminated, leading to hydraulic discharges that depend predominantly on land use.

The City of Woodbury has experienced a steady growth rate over the past few years to reach a 1990 census population of 20,075. This growth trend is expected to continue with a population of 48,700 (City of Woodbury projections) anticipated for the year 2000. Based on proposed land use and the experience of similarly sized cities in the Twin Cities metropolitan area, Woodbury's full-development population is projected to be 100,000 people. This includes a full-development population of approximately 47,000 inside the 1999 Metropolitan Urban Service Area (MUSA) boundary.

Since properly designed and constructed sanitary sewer pipes have long life expectancies, it is reasonable to assume that the full-development population will be reached before facility replacement

becomes necessary. None of the facilities shown in Figure 10 or described in this report's appendices are interim facilities. The facilities shown in the figure 10 and described in this report all support full-development of the community.

Land Use

The Year 2000 City of Woodbury Land Use Plan that guided trunk system development is presented in Figure 2. In order to estimate the volume of wastewater flow anticipated, the Land Use Plan was used to divide the City into land use types. Table 11.3 provides descriptions of these land uses. Appendix 11-1 lists the estimated acreage for each land use type, while Table 11.2 summarizes city-wide coverage of each land use category.

The developable acreage in Appendix A and Table 11.2 is measured in gross developable acres, which is the total acreage reduced by undevelopable areas such as open space and interstate freeway right-of-way. In contrast, the gross developable acreage does include small parks and local street rights-of-way.

Lot counts (1991 and 1998) and per unit flow generation rates were used in determining expected wastewater flow from existing residential developments.

One variation from the Land Use Plan occurs in the area outside the proposed 2020 Metropolitan Urban Service Area (MUSA) boundary. The Land Use Plan currently designates certain areas outside the 2020 MUSA as Urban Reserve. It is assumed that these areas will ultimately be opened up to municipal sewer service, with a corresponding increase in development density. Therefore, for trunk sewer planning purposes, it was assumed that these areas would be developed as Urban Mixed Residential with an average density of 3.5 dwelling units per acre. It is anticipated that definitive land use plans will be available in this area at the time the trunk sewers are installed and that the final system design will be based on that land use.

Figure 3 shows how Woodbury's MUSA expansion is proposed to proceed over the 2003 to 2020 time period. This phasing map is only a guide. Actual phasing and development rates depend on economic and demographic factors that cannot be adequately assessed at this time. Modifications to this proposal may also occur as City priorities and goals change over time.

The current phasing plan anticipates that Phase 4 will occur after 2020. If excess sanitary capacity exists in Woodbury's current system, the City may decide to begin phase 1 (2003 – 2010) earlier. The City would do this to avoid a precipitous decline in the 2000-2003 residential development rate. This decline might occur as land in the 1999 MUSA is developed before a South Washington County Interceptor becomes operational.

Figure 2, Land Use Plan 81/2 by 11

Figure 3 – City of Woodbury Development Phasing Map (Color 81/2 x 11)

Table 11.2 - Land Use Summary

Use	Acres	Percentage
Platted/Planned		
Mixed Residential	5,284	23
Medium Density Residential	401	2
High Density Residential	451	2
Future Mixed Residential		
Mixed Residential	5,158	23
Urban Reserve	1,936	8
Total Residential	13,195	58
Mixed Use	80	1
Places to Work	2,193	9
Places to Shop	669	3
Public Spaces	614	3
City Center	103	<1
Open Space	2,980	13
Undevelopable, Rural Estate	2,926	13
Total	**22,800**	**100**

Table 11.3 - Land Use Type Descriptions

1. Existing Residential - Includes all land, which is presently developed residential, and those areas where approved plans and plats are available.

2. Urban Reserve - Areas not otherwise designated or served with City utilities.

3. Rural Estate - Residential development at one dwelling unit per 3.0 acres. Not used in computing the future sewer flows.

4. Low Density Residential (LD) - Single family residential development at a density of about 2 dwelling units per acre.

5. Medium Density Residential (MD) - Mix of high density single family clusters, townhouses, smaller multiple family structures and occasional apartment buildings at a density range of 4-6 dwelling units per acre.

6. High Density Residential (HD) - Variety of high density buildings as well as a controlled mixture of lower density residential classifications at a density range of 6-10 dwelling units per acre.

7. Urban Mixed Residential – A mixture of single and multi-family residential development. Applies to undeveloped areas within the MUSA and outside the MUSA. Average density is approximately 3.5 units/acre.

8. Places to Work - Includes limited, neighborhood, roadside, and general business, as well as general industrial and office usage.

9. Places to Shop – Includes community and regional shopping centers.

10. Public spaces - Includes churches, golf courses, and public service facilities (parks, minor lakes, fire stations, libraries, utility structures, etc.).

11. City Center - Includes many types of development adjacent to the City's administrative center.

12. Undevelopable - Includes floodplains, wetlands, railroad and major highway rights-of-way.

13. Mixed Use – Mix of land uses described above.

Population

Population projections for the City of Woodbury were developed for use in the evaluation of the trunk sanitary sewer system as well as other planning efforts. Population projections are given in Tables 11.4 and 11.5.

Table 11.4 – Community Forecasts,
From Census Data and Metropolitan Council Projections

Year	Households	Employment	Total Population	Sewered Population
1960	--	--	3,014 *	
1970	--	--	6,184 *	
1980	--	--	10,297 *	
1990	--	--	20,075 *	18,100
1995	10,857	8,495	31,258	29,280
2000	15,300***	11,200***	43,500***	37,400**
2005	18,150***	12,450***	49,750***	45,850**
2010	21,000***	13,700***	56,000***	54,300**
2015	23,500***	14,800***	61,750***	60,850**
2020	26,000***	15,900***	67,500***	67,400**

**Census data*
***Revised Metropolitan Council Population Projections- April, 1999.*
****From Metropolitan Council's Water Resources Management December 1996 Policy Plan.*

Table 11.5 – Community Forecasts,
From Census Data and City of Woodbury Projections

Year End	Households	Total Population	Sewered Population
1960	--	3,014 *	
1970	1,399	6,184 *	
1980	3,232	10,297 *	
1990	6,927	20,075 *	18,100
1995	11,455	32,646	30,660
2000**	17,401	48,657	46,643
2001**	17,950	50,177	48,136
2002**	18,439	51,532	49,463
2003**	19,115	53,404	51,308
2004**	19,791	55,277	53,152
2005**	20,467	57,149	54,997
2010**	23,762	66,277	63,986
2020**	29,926	83,351	80,783
Phase 4***	32,366	90,110	87,431

**Census data*
***City of Woodbury Projections*
****Phase 4 occurs in 2020-2025 period and is included here for illustrative purposes only*

The census data are for 1960, 1970, 1980, and 1990 and include the total population in the City. The Metropolitan Council projections are from the December, 1996 demographic forecasts, and include both the total and the sewered population. The Metropolitan Council population estimates predate the year 2000 City of Woodbury Comprehensive Plan. The City of Woodbury estimates are based explicitly on the year 2000 Land Use Plan and the proposed development phasing shown in Figures 2 and 3, respectively. In this manner, the forecasts of Table 11.5 supersede those of Table 11.4.

The Urban Mixed Residential land use designation covers the majority of future residential development outside the 1999 MUSA boundary. As shown in Table 11.3, the City anticipates that this land will develop at an average density of 3.5 dwelling units per developable acre. This is a

general density guideline and actual densities for individual developments might vary significantly. Since the location of these pockets has not been established, it was necessary to provide approximately 25 percent excess sanitary sewer capacity system wide. The system designed in this manner can serve an estimated population of 125,000 people.

The sewage flows that system oversizing can accommodate are designated "system design flows" and represent an estimate of sewage generated by a full-development population of 125,000 people. The "projected flows" are a percentage of the "system design flows" (approximately 25 percent less), and represent the anticipated sewer flows for Woodbury at a full development population of 100,000 people. The difference between these two flows is the "system reserve capacity." In effect, the system is designed for a larger population to maintain flexibility in applying density requirements to future development.

As described above, the facilities described in this report are designed to serve a population of 125,000 people, though Woodbury's projected full-development population is approximately 100,000 people. Though the phasing scenario depicted in Figure 3 shows a growth of approximately 600 residential units per year, actual growth rates may be lower due to economic and demographic factors. Ultimately, growth rates affect construction timing and not system design. For this reason, Woodbury's ultimate sanitary sewer system will look similar to that described in Figure 10, regardless of the development rate.

11.7 Design Criteria

Wastewater Flows

Sub-district by sub-district, ultimate wastewater flows were calculated by applying unit flow rates to each of the land use categories. The unit wastewater flow rates are presented in Table 11.6.

Table 11.6 gives the unit rates for existing and future residential development. Nonresidential flows are determined on an area basis. The unit flow rates presented in Table 11.6, and used for system design, are in accordance with standard engineering practice and are generally considered conservative.

Average full-development wastewater flows, based on the unit rates in Table 11.6, are presented in Appendix 11-2 for each of the sanitary sewer sub-districts. Point by point, these sub-district average flows are added to determine average flows in the sanitary sewer system. A factor, called the peak flow factor, is then applied to these cumulative average flows to determine the system design flow. The peak flow factor accounts for the difference between average daily flow and the peak flow during a day. Since the pipe network must pass the largest flow during any given day, the peak flow dictates pipe design.

The City's wastewater characteristics are presented in Table 11.7. Currently, Woodbury generates about 115 gallons of wastewater per capita per day (gcd). This rate includes an estimated 15 gcd of infiltration and inflow (I/I). The 115 gcd wastewater flow was obtained by dividing measured average wastewater flows by the total connected population. Based on records of winter water demands, the actual per capita wastewater flow was estimated to be about 100 gcd. The remaining 15 gcd was considered I/I. The 100 gcd figure includes current commercial, industrial, and residential flows. As commercial/industrial development increases, per capita rates will also increase. Per capita

rates are expected to increase to about 140 gcd by the year 2010, peaking at an ultimate per capita flow of about 150 gcd at full development.

Table 11.6 - Unit and Area Wastewater Flows

Land Use Type	Persons/ Unit	Gal/Cap/ Day (GCD)	Gal/Unit/ Day (GUD)	Units/ Acre	Gals/Acre/ Day (GAD)
Existing: Mixed Residential / Low Density (LD)	2.77	100	277	2.0	600
Existing: Medium Density (MD)	2.77	95	263	5.0	1,200
Existing: High Density (HD)	2.77	80	221.7	10.0	1,500
Future: Mixed Residential	2.77	100	277	3.5	970
Existing and Future: Places to Shop	--	--	--	--	1,200
Existing and Future: Places to Work	--	--	--	--	1,500
Existing and Future: City Center	--	--	--	--	1,500
Existing and Future: Mixed Use	--	--	--	--	1,786
Existing and Future: Public Spaces	--	--	--	--	250

Table 11.7 - Wastewater Characteristics

Item	Design (Full Development)	Existing
Per Capita Flow *	135 gcd **	100 gcd **
5-Day BOD	200 mg/l	***
Suspended Solids	220 mg/l	***
Per Capita I/I	15 gcd	15 gcd ****

* *Does not include per capita I/I*
** *Includes commercial, industrial, public flows*
*** *No data available*
**** *Estimated*

At the present time, there is one major industry in Woodbury whose average daily sewage flow exceeds 50,000 gallons. The discharger and their average daily sewage flow are as follows:

- Land O Lakes 97,800 gal/day

There are no known industries in Woodbury whose wastewater contains toxic substances. At this time, no industries in the City require pretreatment of their wastewater before discharge into the City's system.

Tables 11.8 and 11.9 present Woodbury's "system design flows" and "projected flows," respectively. The "system design flows" are based on the Land Use Plan presented in the City of Woodbury's 2000 Comprehensive Plan and as Figure 2 in this report. The phasing of flows is based on the development phasing presented in Figure 3.

The City of Woodbury "projected flows" are a percentage of the "system design flows" and are based on a projected full development population of approximately 100,000 people. This projected full-development population is based on an analysis of actual development densities and on a sub-district by sub-district analysis of potential park dedication, wetland locations, school locations, and other contingencies that ultimately reduce the development density. The difference between the "system design flows" and the "projected flows" is the "system reserve capacity." This capacity is available to serve areas of localized higher densities or, possibly, other municipalities. Met Council projections are presented in Table 11.10.

Table 11.8 – Wastewater Flows
System Design

	Year	Estimated Average Flow to the Cottage Grove WWTP (MGD)	Estimated Average Flow to the Metropolitan WWTP (MGD)
	Current*	0	8.92
Phase 1	2000	0	9.16
	2001	0	9.40
	2002	0	9.64
	2003	5.01	4.87
	2004	5.24	4.87
	2005	5.49	4.87
	2006	5.73	4.87
	2007	5.97	4.87
	2008	6.22	4.87
	2009	6.46	4.87
	2010	6.70	4.87
Phase 2	2011-2015	7.91	4.87
Phase 3	2015-2020	9.11	4.87
Phase 4		10.32	4.87
Future Phases**		12.25	4.87

* *Based on full development of the 1999 MUSA.*
** *Full development*

Table 11.9 – Wastewater Flows
Projected Flows

	Year	Estimated Average Flow to the Cottage Grove WWTP (MGD)	Estimated Average Flow to the Metropolitan WWTP (MGD)
	Current*	0	8.68
Phase 1	2000	0	8.93
	2001	0	9.08
	2002	0	9.24
	2003	4.65	4.74
	2004	4.80	4.74
	2005	4.96	4.74
	2006	5.11	4.74
	2007	5.27	4.74
	2008	5.42	4.74
	2009	5.58	4.74
	2010	5.73	4.74
Phase 2	2011-2015	6.51	4.74
Phase 3	2016-2020	7.28	4.74
Phase 4		8.05	4.74
Future Phases**		9.29	4.74

**Based on full development of the 1999 MUSA.*
*** Full development*

Table 11.10 – Wastewater Flows
Met Council Projections

	Year	Estimated Average Flow to the Cottage Grove WWTP (MGD)	Estimated Average Flow to the Metropolitan WWTP (MGD)
	Current	0	4.95
Phase 1	2003-2010	4.97	2.62
Phase 2	2011-2015	5.65	2.96
Phase 3	2016-2020	6.32	3.29
Phase 4		NA	NA
Future Phases		NA	NA

Note: Information obtained from the Metropolitan Council "Water Resources Management Policy Plan" of December 1996. "NA" indicates years for which data is not available.

It bears repeating that "projected flows" describe the City of Woodbury's use of its own trunk facilities and Metropolitan Council's interceptor facilities.

"System Design" flows determine the design requirements of the City's trunk system. Because the Comprehensive Plan uses only general density guidelines, localized areas of higher density may appear anywhere. For this reason, it is necessary to provide excess capacity in all trunks to accommodate those limited areas where higher densities might appear.

Infiltration/Inflow

The design flows presented in Tables 11.8, 11.9, and 11.10 incorporate an allowance for an average of 15 gallons per capita per day of extraneous water entering the sanitary sewer system through infiltration and inflow (I/I). Current design specifications limit infiltration to 100 gallons per day per inch of diameter per mile of pipe.

In the 1980 "Comprehensive Sewer Policy Plan", the per capita wastewater flow in the City was estimated at 130 gcd including approximately 40 gcd of I/I. At that time, the Metropolitan Council Environmental Services (then the Metropolitan Waste Control Commission) classified Woodbury's sewer system as having "excessive or potentially excessive I/I". As such, the City received a Federal grant in July, 1980 to begin a study of their I/I problem. The I/I study was finished in November, 1981.

Since then, the City has taken numerous steps to minimize I/I. These steps include ensuring proper construction of all new sanitary sewer by stringent testing of all new sanitary sewer lines, use of manholes with concealed pick holes, and proper maintenance of the existing system, including manhole leak detection and sealing. The City has rehabilitated those areas where the study showed that I/I elimination was possible and cost effective.

City ordinance prohibits roof and foundation drains to be connected to the sanitary system. The ordinances state that "No rain spout or other form of surface drainage, and no foundation drainage or sump pump are allowed to be connected or discharged into any sanitary sewer". Similar provisions are included in the City's Building Regulations.

Well-drained soils underlay much of Woodbury. The majority of the sanitary sewer in the City is above the water table except for some of the trunks installed in the late 1960s and 1970s. These trunks below the water table, combined with Woodbury's relatively small population at that time, contributed to the 40 gcd of I/I estimated in 1980. In the last 20 years, Woodbury's population has more than tripled with virtually no additional trunk sewers built below the water table. This fact alone should significantly decrease the 1980 I/I estimate of 40 gcd. The current per capita I/I wastewater flow was estimated to be 15 gcd based on actual wastewater flows and estimated wastewater flow rates.

Ongoing City I/I Efforts and Maintenance

The City of Woodbury has an ongoing program to maintain its sanitary sewer system as well as identify and resolve inflow and infiltration problems. The City conducts an annual sewer line televising project. Where televising indicates problem areas, the City programs a repair or continued monitoring. The City projects that 60,000 feet will be televised in the year 2000 alone. The city also televises all new facilities before they are placed in service. Additionally, after major roadway maintenance projects, sanitary sewer pipe in the project area is televised to ensure that no damage has occurred.

In the last four years, the City has had two major rehabilitation projects that went beyond normal system maintenance. City of Woodbury Staff obtained grants, or forgivable loans, for these two projects. One, completed in 1995, sealed 58 manholes, installed 10 chimney manhole seals and repaired 2 leaking pipe joints. The 1998 project involved sealing 25 leaking manholes and relining the trunk sewer line that passes under Wilmes Lake. Final reports were submitted for these projects, as were annual follow-up reports – as required.

The City of Woodbury has annual maintenance that includes flushing the dead ends of all gravity sewer lines. Each year, 25 percent of the sanitary sewer system is cleaned using high pressure jetting equipment. This cleaning schedule has resulted in substantial overtime costs the last two years. Chemical intervention has been made available at two major sanitary sewer force mains. This chemical treatment attempts to limit hydrogen sulfide gas formation. Hydrogen sulfide has an offensive odor and can corrode pipes. With the completion of the force main extension project from the Autumn Drive booster station, the City may reduced the need for some of the chemical costs related to this sanitary sewer line.

Appendix 11-7 includes correspondence relating to recent I/I maintenance efforts.

System Design

The trunk sanitary sewer system must be capable of handling not only the average flows, but also anticipated peak flows. These peak flows are obtained by multiplying average flows by a variable factor. This factor, called the Peak Flow Factor, generally decreases with increasing average flows. The Peak Flow Factors used in preparing this report are shown in Figure 4. These values are considered conservative and are widely used for planning purposes in municipalities similar to Woodbury.

The design flows for each segment of pipe are presented in Appendix 11-3. This information includes the reference points of the segment involved, the average flow from Appendix 11-2, the design Peak Flow Factor, and the resulting design flow. Appendix 11-3 includes the design sizes for proposed trunks and more detail about the existing/proposed pipe capacities based upon inlet or outlet control analyses.

The Metropolitan Council Waste Discharge Rules set forth operating requirements for sanitary sewer systems. These requirements are being evaluated for incorporation into City policy and ordinance.

FIGURE 4 (8-1/2 BY 11) (PEAK FLOW FACTOR)

11.8 Full-Development System Description

General

The full development trunk sanitary sewer system layout for the City of Woodbury is presented on Figure 10 at the back of this report. This map shows major district and subdistrict boundaries, existing and proposed trunk sanitary sewers, lift stations, and force mains. In addition, sizes of all trunk sewers are shown with reference points along each pipe. Appendices 11-3 and 11-4 present design flow and existing/proposed capacities for each sewer segment (shown on Figure 10). Appendix 11-6 provides detail on the two new lift stations proposed in this report. Figure 10 shows these proposed lift stations as well as the City's current complement of sanitary lift stations.

The proposed trunk sanitary sewer alignments are preliminary and should be reviewed at the time of final design to ensure conformance with existing and proposed development. In most cases, the alignments closely follow natural drainage ways. Major changes in alignment are not recommended because these could lead to excessive pipe depths and thus increased construction costs.

Private wastewater treatment facilities are prohibited in the City of Woodbury.

Metropolitan Facilities

As indicated in Appendix 11-1 of this report, there are approximately 16,900 developed and developable acres in the City of Woodbury that will be served by Metropolitan facilities. Of this total, approximately 12,800 acres, corresponding to the Central and Valley Branch Districts, could be served by the future MCES South Washington County Interceptor. MCES has decided on a location for a new Cottage Grove wastewater treatment plant, and has finalized the alignment for the interceptor, which will generally follow County Road 19 south to Highway 61.

The MCES Centralization/Decentralization (C/D) Study recommended that the Cottage Grove Interceptor be operational by the year 2010 and that its construction be done in conjunction with the construction of storm water trunk improvements along the Cottage Grove ravine. The C/D study also warned that severe development restrictions may be necessary in Woodbury if the Cottage Grove Interceptor is not built by 2010 or the Carver Lake Interceptor is not upgraded before the year 2010. This interceptor, now called the South Washington County Interceptor (SWCI), is now anticipated to be operational in early 2003.

The existing Cottage Grove plant has primary and secondary treatment with a liquid treatment process of activated sludge and a solid process consisting of gravity thickening and anaerobic digestion. The final phase of the plant upgrade, completed in December, 1995, increased plant capacity to 2.54 MGD. The C/D study recommended the construction of a new plant in Cottage Grove to accommodate wastewater flows from Cottage Grove, Woodbury, and Lake Elmo.

Approximately 4070 developed and developable acres in the western portion of Woodbury, corresponding to W.O.N.E., Lower Afton and Carver Lake Districts, feed wastewater through MCES facilities to the Metropolitan Wastewater Treatment Plant located at Pig's Eye Lake in St. Paul. The Metropolitan plant is an advanced activated sludge treatment plant having primary and secondary

treatment as well as nitrification, filtration, chlorination and ammonia removal. The Metropolitan plant has a capacity of 250 MGD and presently treats between 230 and 235 MGD, providing service for Minneapolis, St. Paul, the region's older suburbs and some developing communities like Woodbury.

The Metropolitan wastewater conveyance facilities that serve the City of Woodbury are described below.

Carver Lake Interceptor (MCWS-7402)

The Carver Lake Interceptor was constructed in 1976 and will ultimately serve the southern portion of Woodbury's MUSA (Carver Lake District) and a part of Maplewood. It starts in Woodbury near the north end of Carver Lake at Century Avenue. It conveys Woodbury's wastewater flow to the Point Douglas Interceptor – first along a series of easements and then along Carver Avenue. The Point Douglas Interceptor, constructed in 1968, runs northerly along Point Douglas Road and discharges into the Metropolitan Wastewater Treatment Plant. Inside Woodbury, City trunk runs along the northern edge of Carver Lake and then into the Windwood and Woodlane Hills subdivisions.

Historically, the allocated capacity in this facility for Woodbury was 2.87 mgd. In general, MCES no longer applies allocations to municipalities that discharge into MCES interceptors. The Carver Lake Interceptor also serves the Colby Lake area on an interim basis. Interim flow from the Colby Lake lift station will end when the MCES South Washington County Interceptor and the new Cottage Grove treatment plant are constructed.

Based on unit flow rates from Table 11.6 and development as of the spring of 1999, Woodbury's contribution to the Carver Lake Interceptor is estimated at 1.6 mgd average flow from the Carver Lake district and 1.6 mgd average flow from the Colby Lake lift station. This leads to a combined 3.2 mgd average flow and an 8.3 mgd peak flow. Certain parts of Woodbury's trunk system that are tributary to the Carver Lake Interceptor are undersized in regard to interim peak flows. These undersized pipes are detailed in section 11.10. Once the MCES SWCI is operational, the Colby Lake lift station flow will be eliminated. Under ultimate development of the Carver Lake district, Woodbury's contribution to the Carver Lake Interceptor will then consist of a 2.0 mgd average flow.

Lower Afton Interceptor (1-MW-410)

This facility, completed in 1963, will ultimately serve a small geographic area of Woodbury along Lower Afton Road between Century Avenue and I-494. Previously, Woodbury's allocated capacity in this interceptor was 1.33 mgd. The Lower Afton Interceptor also serves the northern part of Carver Lake District on an interim basis. Once the northern part of the Carver Lake is rerouted away from this interceptor, Woodbury's flow will be well below its historic allocation (see Appendices 11-2 and 11-3).

W.O.N.E. Interceptor (1-WO-500)

The W.O.N.E. Interceptor, constructed in 1968, was designed to relieve several smaller facilities and to provide service for the northern portion of Woodbury, Landfall, Oakdale, Lake Elmo and a part of Maplewood. In Woodbury, the W.O.N.E. Interceptor branches into two separate sewer lines. One line runs easterly around the south side of Battle Creek Lake, crosses Interstate 494, and then runs

north under Interstate 94 to provide service for portions of Lake Elmo and southeast Oakdale. The other branch runs north around the west side of Battle Creek Lake and crosses Interstate 94 to provide service for Landfall and Oakdale.

Historically, Woodbury's allocated capacity in this interceptor was 2.7 mgd. The W.O.N.E. Interceptor also serves the Wilmes Lake area on an interim basis, via the Wilmes Lake lift station and forcemain. Once the MCES SWCI is operational, the Wilmes Lake lift station flow will be eliminated.

South Washington County Interceptor

In the spring of 1999 a site for the Southeast Wastewater Treatment Plant had been picked. Also in 1999, MCES picked County Road 19 as the alignment for the SWCI within the City of Woodbury. This alignment was chosen over both the County Road 17 and County Road 15 alignments. Subsequent to choosing a County Road 19 alignment in Woodbury, County Road 19 was also chosen as the alignment for the Cottage Grove portion of the SWCI.

The MCES South Washington County Interceptor will extend from the Colby Lake lift station south to the corporate limit and into Cottage Grove – ending at the Southeast Wastewater Treatment Plant. MCES will rebuild and own the Colby Lake lift station. The alignment will generally follow County Road 19, though some portion will run approximately 1300 feet west of the County Road due to grade issues near Bailey Lake. The proposed interceptor is shown on Figure 10. Each of the interceptor pipe elements are summarized in Appendix 11-4.

The interceptor and the treatment plant are expected to be fully operational in the Spring of 2003.

Intercommunity Flows

There are a total of 12 locations near the Woodbury city limits where intercommunity flows exist or are proposed. A listing of these locations and their average and peak flows is presented in Table 11.11. These points are also shown in Figure 10 at the end of this report. The design of Woodbury's sanitary sewer system does not account for flow from Afton.

Additionally, on-site wastewater disposal systems will continue to serve the rural estate portions of the Cottage Grove and Newport districts. Additional Rural Residential areas are planned around Bailey Lake and near Military Road in the southwest part of the City. These would also be served by on-site disposal systems. Though capacity exists in the system for Rural Residential areas adjacent to Bailey Lake and within the sub-districts CG-1 and CG-2 (Cottage Grove District), sanitary sewer service is not proposed for these areas.

Table 11.11 - Intercommunity Flows

Location	From	To	Avg. Flow (MGD)	Peak Design Flow (MGD)
Pt. W2.3	Oakdale	Woodbury	2.50*	6.75
Pt. C55.1	Woodbury	Cottage Grove	11.22	22.44
Pt. C58.1	Cottage Grove	Woodbury	0.151**	0.590
Pt. C56.3	Woodbury	Cottage Grove	1.08	3.34
Pt. C54.1	Woodbury	Cottage Grove	0.095	0.378
Pt. CL6.6	Woodbury	Maplewood	2.09	5.85
Pt. CL8.1	Woodbury	Maplewood	0.118	0.471
Pt. W4.1	SE Oakdale, Lake Elmo	Woodbury	0.192 *	0.730
Pt. W1.2	Woodbury	Maplewood	0.096	0.382
Pt. W2.2	Woodbury	Maplewood	2.29***	6.42
Pt. LA.5	Woodbury	Maplewood	0.277	1.03
NA	Woodbury	Newport	0.04	0.160

* *Note: Existing flow, obtained from MCES.*
** *Note: From 1992 Cottage Grove CSPP*
*** *Note: Does not include Oakdale and Lake Elmo flow into W.O.N.E.*
Note: Intercommunity flows, where not otherwise indicated, represent "system design flows" and are derived from Appendix C.

Central District

The Central District is the largest district in Woodbury and encompasses approximately 14,000 acres. Natural drainage is toward the south via a central system of lakes and wetlands. Almost one-half of the Central District lies within the current Metropolitan Urban Service Area. In the near-term, development will primarily take place in this area.

The Central District drains through a series of depressions that begin in Lake Elmo and pass through the City of Woodbury. Some notable examples include Markgrafs Lake, Powers Lake, and Colby Lake, and – in Cottage Grove - Gables Lake. The Metropolitan Council's South Washington County Interceptor (SWCI) will extend through the Central District from the Colby Lake lift station south to the City border. Several local trunk sewers will extend from the interceptor to provide sewer service to local areas in Woodbury.

The Central District and the Valley Branch District are the only districts where future City trunk construction will occur. To ease discussion and recall of the various trunk alignments, each has been given a name. These names are summarized in Table 11.12 (see also Figure 10).

Table 11.12
City Trunk Naming

From Point	To Point	City Trunk Name
V4.1	C20.3	Valley Branch North Trunk
V6.1	C20.1	Valley Branch South Trunk
C14.1	C11.1	Powers Lake Trunk
C20.1	C23.3	Eagle Valley Trunk
C41.1	C45.3	Dale Road Trunk
C36.1	C50.3	Bailey Lake Trunk
C52.1	C52.2	Bailey Lake East Trunk
C53.1, C56.1	C56.3	Gables Lake Trunk

Woodbury's trunk system will provide gravity sanitary sewer service to the entire Central District with the exception of the area immediately adjacent to Powers Lake. A 250-gallon per minute lift station (lift station # 10) was installed near the northwest portion of the lake to pump flow from the south portion of district C-12.

The existing City lift station at Colby Lake will be replaced by an MCES owned and operated lift station. MCES will construct this lift station in conjunction with the South Washington County Interceptor (SWCI).

Excess capacity exists in the Bailey Lake Trunk for the estate areas, both existing and future, around Bailey Lake. Service options have been developed for these areas, though no service is currently proposed.

The current MCES proposal for the interceptor creates an island in sub-district C-52 that cannot be served by gravity sanitary sewer. This area consists of approximately one-third of the SW 1/4 of the NW 1/4 of section 35 and a small portion of the NW 1/4 of the NW 1/4 of section 35 – or

approximately 20 acres total. Specifically, technical and cost requirements make it infeasible to serve this area. Development of this low area would require substantial amounts of fill. Therefore, no City lift station is proposed here, though capacity does exists in the Bailey Lake East Trunk if a small local lift station were constructed to serve this area.

The Wilmes Lake to Colby Lake connection is the last major piece of municipal trunk remaining to be built within the 1999 MUSA boundary. This 36-inch pipe will be constructed so that this connection is made about the time that the SWCI becomes operational.

As noted in the discussion of the Cottage Grove District, sufficient capacity exists in the proposed Bailey Lake Trunk to serve Cottage Grove sub-districts CG-1 and CG-2. Even though the 2000 CSPP proposes that these sub-districts not be served, this capacity remains in reserve since previous plans have shown service to these two sub-districts. Should service be required, due to either land use changes or failing septic systems, for example, these districts (shown on Figure 10) could connect into the proposed Bailey Lake Trunk via node C48.1.

The City of Woodbury Gables Lake Trunk has been designed to provide service to Cottage Grove District CGR-6 (1992 Cottage Grove "Comprehensive Sewer Policy Plan"). The Cottage Grove system will connect to the Gables Lake Trunk at point C58.1.

Valley Branch District

The Valley Branch District lies in the northeastern portion of the City. The land here generally slopes to the east while sanitary sewer pipe will generally run to the west. Since pipe will run against grade, deep pipe and lift stations become necessary.

The southern portion of the Valley Branch District will be one of the last areas of the City to receive sanitary sewer service. The northern portion of the district will be one of the first. For this reason it was necessary to split the district's system so that infrastructure construction might fit better into proposed phasing, thereby minimizing sanitary sewer construction across undeveloped areas.

The land use plan for the northern portion of the Valley Branch District is for commercial and industrial land uses. The City will bring sanitary sewer service to this area via the Valley Branch North Trunk, which includes a lift station and force main. This trunk will connect to the Eagle Valley Trunk at or near node C20.3 (see Figure 10). At some point the Metropolitan Council Environmental Services (MCES) may request use of this lift station and force main to provide some capacity to Lake Elmo. At that time the lift station would be upgraded and a second, parallel force main would be added. MCES would be responsible for these upgrade costs.

The southern portion of the Valley Branch District will be served by the Valley Branch South Trunk and will also connect to the Eagle Valley Trunk, though this connection will be further to the east at node C20.1 (see Figure 10). This connection to the Eagle Valley Trunk will also be via a lift station and forcemain.

W.O.N.E. District

The W.O.N.E. District encompasses approximately 2,600 acres in northwest Woodbury. This area generally drains to the northwest. The City trunk system that serves the W.O.N.E. District was constructed in 1970 as an extension of the W.O.N.E. Interceptor.

The City trunk system includes a 21-inch pipe along the northern edge of Tamarack Swamp to Bielenberg Drive (point W5.1). An 18-inch pipe follows Bielenberg Drive south to the southern edge of Tamarack Swamp (point W13.2). From W13.2, a 15-inch pipe runs along the southern edge of Tamarack Swamp to point W13.1. Additional 12-inch trunk lines complete the City's trunk system in this area. The trunk lines referenced above are shown on Figure 10.

In 1986, the City received approval for a major Comprehensive Plan Amendment that added approximately 2,000 acres to the Metropolitan Urban Service Area. This 2,000 acres generally surrounded the Wilmes Lake. To serve this area, the Wilmes Lake lift station and a 16-inch force main were built. The Wilmes Lake forcemain connects to the W.O.N.E. at point W5.2. In 1999 the City extended the 16-inch force main to point W4.3 to take advantage of additional capacity available there.

As stated earlier, once the MCES South Washington County Interceptor (SWCI) is constructed and the new treatment plant is on line, then the Wilmes Lake lift station, booster station, and force main will be abandoned. Currently, the southwest portion of district C-5 flows into district W-10 via lift station #6 and a short 6-inch force main. Once the SWCI is constructed, this lift station will also be abandoned, and this flow will join the other central district flows.

Carver Lake District

The Carver Lake District encompasses approximately 2,250 acres in west central Woodbury. This area generally drains to the west. The City trunk system that serves the Carver Lake District was begun in 1977.

The City trunk system includes a 24-inch pipe was around the north side of Carver Lake. This connects the existing Carver Lake Interceptor to point CL6.4. At CL6.4 the line branches into a 15-inch pipe that extends north to serve the Wooddale Industrial Park and the Woodview Acres development and a 21-inch segment that further branches and that serves the Windwood and Woodlane Hills developments.

In 1979, a proposal to construct a large residential planned unit development (PUD) around Colby Lake was approved by the Metropolitan Council. In the early 1980's the Colby Lake lift station and its 16-inch force main were built to serve this PUD. The Colby Lake force main discharges to point CL6.2 on the Carver Lake trunk. Again, once the MCES SWCI is constructed, this force main will be abandoned. At that time the Colby Lake lift station will be reconstructed by MCES and its flow directed into the new interceptor.

To complete the trunk sanitary sewer facilities for the ultimate system in the Carver Lake District, a 12-inch sewer line was constructed in 1998 along the west side of I-494. This line runs from the existing interim lift station (lift station #2) at point CL1.1 to the City trunk line north of Carver Lake. This line is intended to serve Carver Lake subdistrict CL-1. Since the Carver Lake City trunk system and interceptor are approaching capacity, CL-1 will not be connected to this trunk until the MCES SWCI is constructed and Colby Lake lift station flow no longer enters the Carver Lake system. Until that time, CL-1 continues to flow via the interim lift station into the Lower Afton system.

Node CL-8.1 connects sanitary sewer service from sub-district CL-8 to the Carver Lake Interceptor. This connection is proposed to occur via City of Maplewood lateral sanitary sewer into the Carver Lake Interceptor, which runs under Century Avenue in this area.

Lower Afton District

The Lower Afton District is the smallest of all of the sewer districts and encompasses approximately 250 acres in northwest Woodbury. This district is served by a City trunk sewer on Valley Creek Road that discharges into a Metropolitan Interceptor near Parkwood Drive in Woodbury. This interceptor was constructed in 1963 and has reserve capacity to provide temporary service for subdistrict CL-1 until sufficient capacity is released in the Carver Lake system by rerouting of the Colby Lake lift station discharge into the MCES SWCI. The Lower Afton Interceptor also has the capacity to handle the flows from Carver Lake districts CL-2 and CL-3.

Cottage Grove District

The Cottage Grove District encompasses approximately 1,400 acres of terrain characterized by rolling hills, farm fields and occasional dense tree cover. Natural drainage is south toward Cottage Grove and through existing rural estate development in district CG-3. No sanitary sewer is proposed for this district.

Woodbury's 1995 CSPP ("Comprehensive Sewer Policy Plan, Woodbury, 1995") showed sub-districts CG-1 and CG-2 as low density residential, and thus showed sanitary sewer for these areas. This trunk sewer generally ran east and north, against the grade of the land, and connected to the Bailey Lake Trunk at point C48.1 (2000 CSPP numbering). Because this sanitary sewer ran against land grade, pipe depths were deep and two lift stations were required. For this reason, sanitary sewer service to this area was more expensive, on a per acre basis, than other parts of the City. This is one reason why the 2000 Comprehensive Plan designates these areas as rural residential development, served by on-site systems.

The 1999 CSPP proposes a Bailey Lake City Trunk, particularly the stretch from point C48.1to C43.1, with sufficient capacity to accommodate sanitary flow from districts CG-1 and CG-2 if, at some time in the future, service is extended to these areas. As of the year 2000, no such connection is proposed.

Newport District

The Newport District encompasses approximately 825 acres that drain west into the City of Newport. This land contains large areas of dense tree cover. The bulk of this district has developed as rural estate and is served with on-site wastewater disposal systems. No sanitary sewer service is proposed for these areas. Approximately 180 acres in the southern portion of the district does have sanitary sewer service that connects to the City of Newport's system. No further expansion of this sewer service area is anticipated.

Analysis of Trunk Capacities

The full-development trunk sanitary sewer system for the City of Woodbury is presented in Figure 10. Appendix 11-4 shows the existing and proposed trunk capacities, and the design flow for each segment of trunk based upon the computed average flow and the estimated peak flow factor from Figure 5. In general, the system has sufficient capacity to handle design flows with a conservative peak flow factor. However, some existing lines cannot accommodate full development design flows. Table 8.3 lists these lines.

Table 11.13 - Low Capacity Trunks at Full Development

From Point	To Point	Size (in.)	Average Flow (MGD)	Peak Flow Factor	Peak Flow (MGD)	Full Flow Capacity (MGD)
CL 9.1	CL 6.1	12	0.5565	3.4	1.8921	1.21
W 13.1	W 13.2	15	0.6427	3.4	2.1853	1.66

Full-development design flows are, as detailed earlier in this report, relatively conservative. For this reason, trunks that show insufficient capacity under these "design" full-development flows are not necessarily undersized relative to the actual full-development flows. In the interim, the pipe reaches shown in Table 11.13 should be occasionally metered. Metering results will determine if further efforts are required.

11.9 Cost Analysis

Trunk Sanitary Sewer Costs

One of the basic objectives of this study was to determine the cost of completing the City of Woodbury's trunk sanitary sewer system and at the same time to determine new trunk area assessments that will insure availability of sufficient funds for future trunk sewer construction.

The cost estimates presented in this report are based on 1999 construction costs and can be related to the and Engineering News Record (ENR) cost index of 6006 (May, 1999). Future changes in this index are expected to fairly accurately reflect changes in construction costs for the trunk sanitary sewer system.

A summary of the estimated system completion costs appears in Table 11.14. A detailed cost estimate is provided in appendices 11-5 and 11-6. These costs include all foreseeable expenses associated with the completion of Woodbury's trunk sanitary sewer system, including trunk sanitary sewer, lift stations, force mains, and land acquisition. A 10 percent contingencies cost has been included in the construction cost. The cost estimates also include a 25 percent factor, applied to both land acquisition and pipe construction, that accounts for engineering, administrative, and financing costs. As mentioned, land and easement acquisition costs are included. Footnotes in appendices 11-5 and 11-6 summarize the cost assumptions.

Table 11.14 - Trunk Sanitary Sewer Cost Summary

District	Estimated Trunk Costs
Central	8,721,092
Valley Branch	3,944,015
Total	**12,665,107**

Area Charges

The City of Woodbury currently recovers the cost of trunk sanitary sewers through a combination of area and connection charges. Table 11.15 summarizes the current charges established by City of Woodbury Resolution No. 2000-07. A copy of this resolution appears in Appendix 11-7.

Table 11.15
2000 Area and Connection Charges

Category	Districts and District Numbers									
	W.O.N.E./ Lower Afton	Carver Lake	Newport	Colby Lake	Wilmes Lake	Woodbury Highlands	Woodbury Highlands	Meadow-view	Glen Eagle	Century Avenue
	1 and 4	2	3	5	6	7	7A	8	9	10
Area Charges ($/ac)	1440.00	1465.00	NA	1585.00	1605.00	1740.00	1855.00	1700.00	2025.00	1820.00
Lateral Benefit ($/front foot)	34.00	34.00		34.00	34.00	34.00	34.00	34.00	34.00	34.00
Connection Charges										
1 to 4 units per acre ($/unit)	480.00	280.00	1045.00	535.00	520.00	645.00	645.00	535.00	640.00	280.00
4 to 8 units per acre ($/unit)	380.00	235.00	NA	435.00	430.00	NA	520.00	435.00	545.00	235.00
Over 8 units per acre ($/unit)	290.00	200.00		355.00	355.00	NA	NA	355.00	460.00	200.00
Industrial and Commercial ($/ac)	1245.00	1100.00		1700.00	1660.00	NA	NA	1700.00	2770.00	1100.00
Other buildings ($/equivalent dwelling unit)	290.00	200.00		355.00	355.00	380.00	390.00	355.00	460.00	200.00

The City has revised its method of determining area charges for the 1999 CSPP over what was used in the 1995 CSPP. Specifically, the City will not apply area charges to the following areas as they appear in proposed plats:

- NWI wetlands plus buffers
- Storm pond dedication
- Major roadway right-of-way
- Greenway Corridors
- Park dedication

The land available for area charge application was further reduced by a 15 percent contingency factor to account additional park dedication and planning contingencies. The total acreage then available for application of area charges was calculated at 5300 acres out of the approximately 7600 developable acres outside the 1999 MUSA boundary. The acreage to which area charges apply is termed the financing area.

Table 11.16 presents a cost recovery analysis based on the following assumptions:

- 20-year break-even.
- No lateral benefit applied to sewer trunk.

The methodology summarized in Table 11.16 leads to an equivalent area charge of $3260 per acre.

Table 11.17 presents a cost recovery analysis based on the following assumptions:

- 20-year break even.
- Lateral benefit of $66 a linear foot applied to 20% of future trunk lines with no lateral benefit assumed for the Wilmes/Colby connection.

The methodology summarized in Table 11.17 leads to an equivalent area charge of $3050 per acre.

Note that equivalent area charges lump together revenue obtained from both area and connection charges.

Table 11.16
Cost Recovery Through Area Charges
No Lateral Benefit Applied

A	B-1	B-2	C-1	C-2	D	E
Phase	**Net Developable (Assessable) Acreage Added - Other than NE Area Commercial**	**Net Developable (Assessable) Acreage Added - NE Area Commercial**	**Net Developable (Assessable) Acreage Added - Column B-1 Reduced by 15% Contingencies**	**Net Developable (Assessable) Acreage Added - Column B-2 Reduced by 15% Contingencies**	**Column C X Area Charge of $3260/AC**	**City Trunk Costs**
(yr)	(ac)	(ac)	(ac)	(ac)	($)	($)
Pre 2003						4,709,915
2003 - 2010	1126	372	957	316	4,149,500	796,724
2010 - 2015	806	281	685	239	3,012,154	3,888,751
2015 - 2020	941	172	800	146	3,085,290	861,944
Phase 4	1025	0	872	0	2,841,326	251,396
Future Phases	1531	0	1301	0	4,242,340	2,156,377
Totals	**5430**	**824**	**4615**	**701**	**17,330,611**	**12,665,107**

Notes: 1) Pre 2003 city trunk costs include NE area trunk at 100% city cost, and Wilmes to Colby connection.
2) Pre 2003 costs include approximately $315,000 (from node C20.4 to C19.2) oversizing costs for future MCES flows.
3) Phase 2 net developable acreage (column B-1) does not include 160 acres within district C-18 (NE 1/4 of section 14) that are outside 1999 MUSA but have already been subject to area charges.

Table 11.17
Cost Recovery Through Area Charges
Lateral Benefit Applied

A	B-1	B-2	C-1	C-2	D	E
Phase	**Net Developable (Assessable) Acreage Added - Other than NE Area Commercial**	**Net Developable (Assessable) Acreage Added - NE Area Commercial**	**Net Developable (Assessable) Acreage Added - Column B-1 Reduced by 15% Contingencies**	**Net Developable (Assessable) Acreage Added - Column B-2 Reduced by 15% Contingencies**	**Column C X Area Charge of $3050/AC**	**City Trunk Costs**
(yr)	(ac)	(ac)	(ac)	(ac)	($)	($)
Pre 2003						4,659,755
2003 - 2010	1126	372	957	316	3,882,201	668,024
2010 - 2015	806	281	685	239	2,818,120	3,513,211
2015 - 2020	941	172	800	146	2,886,545	735,224
Phase 4	1025	0	872	0	2,658,296	219,716
Future Phases	1531	0	1301	0	3,969,060	1,948,477
Totals	**5430**	**824**	**4615**	**701**	**16,214,222**	**11,744,407**

Notes: 1) Pre 2003 city trunk costs include NE area trunk at 100% city cost,
and Wilmes to Colby connection..
2) Pre 2003 costs include approximately $315,000 (from node C20.4 to C19.2) oversizing costs for future MCES flows.
3) Phase 2 net developable acreage (column B-1) does not include 160 acres within district C-18 (NE 1/4 of section 14) that are outside 1999 MUSA but have already been subject to area charges.

The cost recovery described in Tables 11.16 and 11.17 assumes that area charges are applied to recover all trunk costs within a 20-year time frame. Using this methodology to base the area charge rates leads to a fund surplus in "Phase 4" and "Future Phases".

All costs and area chares presented in Tables 11.16 and 11.17 are in 1999 dollars. The area charge is an equivalent area charge and incorporates both area and connection charges. The phasing of developable acreage follows from Figure 3. The phasing of trunk costs comes from Table 11.18 "Capital Improvement Program".

Tables 11.16 and 11.17 are analysis tools only, and are intended to guide future development of area and connection charge rates. Actual area and connection charge rate revisions occur annually by City Council resolution.

11.10 Capital Improvement Program

The installation of the City of Woodbury's trunk sanitary sewer system has kept pace with development in the City. It is anticipated that additions to this sewer system will provide sufficient sanitary sewer capacity for additional development as outlined in the development phasing proposal (Figure 3).

The City of Woodbury Capital Improvement Program is based on the phasing presented in Figure 3 and represents the trunk improvements required to bring service to areas as they open to development. The phasing of trunk elements and their associated costs are presented in Table 11.18. The Capital Improvement Program is intended to serve as a guide for future fiscal planning and should be reviewed annually as more current planning and cost data become available.

Table 11.18
Capital Improvement Program

Year/ Phase	Trunk Sanitary Sewer Element				Trunk Cost ($)	Lateral Benefit ($)	Costs Less Lateral Benefit ($)
	Pipe			Lift Station			
	From Point	To Point	Length				
Pre 2003	C11.2	C17.1	2,800		818,715	0	818,715
	C17.1	C17.2	2,150		792,055	0	792,055
	C23.5	C23.4	650		171,631	0	171,631
	V1.1	C20.4	17,200		1,383,712	0	1,383,712
	C20.4	C19.1	1,400		252,488	18,480	234,008
	V1.1			734,400			
	C19.1	C19.2	2,400		556,914	31,680	525,234
		Subtotals	**26,600**	**734,400**	**3,975,515**	**50,160**	**3,925,355**
2003	C15.2	C12.1	4,200		388,913	55,440	333,473
	C20.2	C20.3	800		65,439	10,560	54,879
	C20.3	C20.4	950		77,708	12,540	65,168
		Subtotals	**5,950**		**532,060**	**78,540**	**453,520**
2004	C20.1	C20.2	2,300		160,191	30,360	129,831
		Subtotals	**2,300**		**160,191**	**30,360**	**129,831**
2005	C14.1	C15.2	1,500		104,473	19,800	84,673
		Subtotals	**1,500**		**104,473**	**19,800**	**84,673**
2006	No Additional Trunks Needed						
2007	No Additional Trunks Needed						
2008	No Additional Trunks Needed						
2009	No Additional Trunks Needed						
2010	No Additional Trunks Needed						
2011-2015	V4.1	V3.1	3,000		318,295	39,600	278,695
	V3.1	V2.1	1,000		127,698	13,200	114,498
	V2.1	V1.1	2,800		517,433	36,960	480,473
	C35.1	C36.1	2,750		191,533	36,300	155,233
	C36.1	C37.1	1,600		130,877	21,120	109,757
	C37.1	C37.2	2,150		251,331	28,380	222,951
	C37.2	C43.1	1,200		165,057	15,840	149,217
	C48.2	C43.1	3,000		245,395	39,600	205,795
	C43.1	C50.1	3,500		812,166	46,200	765,966
	C49.1	C50.1	2,600		275,856	34,320	241,536
	C50.1	C50.2	1,400		324,867	18,480	306,387
	C50.2	C50.3	2,000		360,697	26,400	334,297
	C45.2	C45.3	1,450		167,545	19,140	148,405
		Subtotals	**28,450**		**3,888,751**	**375,540**	**3,513,211**

Year/ Phase	Trunk Sanitary Sewer Element				Trunk Cost ($)	Lateral Benefit ($)	Costs Less Lateral Benefit ($)
	Pipe			Lift Station			
	From Point	To Point	Length				
2016-2020	C48.1	C48.2	2,500		204,496	33,000	171,496
	C40.2	C40.3	2,450		226,866	32,340	194,526
	C40.3	C45.1	3,000		277,795	39,600	238,195
	C45.1	C45.2	1,650		152,787	21,780	131,007
		Subtotals	**9,600**		**861,944**	**126,720**	**735,224**
		Totals to 2020	**68,700**		**8,893,603**	**681,120**	**8,212,483**
Phase 4	C41.1	C40.1	1,200		140,278	15,840	124,438
	C40.1	C40.2	1,200		111,118	15,840	95,278
		Subtotals	**2,400**		**251,396**	**31,680**	**219,716**
Future Phases	C52.1	C52.2	2,200		153,226	29,040	124,186
	C53.1	C58.1	2,200		144,316	29,040	115,276
	C58.1	C57.1	4,200		343,553	55,440	288,113
	C56.1	C56.2	500		34,824	6,600	28,224
	C57.1	C56.2	2,000		212,197	26,400	185,797
	C56.2	C56.3	600		108,209	7,920	100,289
	C56.3	C.G.	1,650		297,575	21,780	275,795
	V6.1	V5.1	2,400		254,636	31,680	222,956
	V5.1			351,000			
	V5.1	C20.1	5,500		256,841	0	256,841
		Subtotals	**21,250**	**351,000**	**1,805,377**	**207,900**	**1,597,477**
		Grand Totals	**98,050**	**1,085,400**	**11,579,707**	**920,700**	**10,659,007**

Note: 1) Lateral Benefit = 66 dollars and applies to 20% of trunk footage.
2) For Wilmes to Colby connection and Lake Road connection no lateral benefit is assumed.
3) For C20.4 to C19.1 and C19.1 to C19.2 approximately $315,000 oversizing costs for MCES flow are included.

11.11 On-Site Wastewater Disposal Facilities

Presently, approximately 4 percent of Woodbury's residents utilize individual on-site treatment systems for wastewater disposal. As of December 1999, approximately 694 facilities operate within the City. The percentage of on-site systems in Woodbury will fall as municipal sewer service is extended throughout the City. Currently the City averages 8 new and 8 replacement systems per year.

Unsewered areas destined for sewer will obtain this service according to the schedule outlined in Table 11.18. At the present time, no significant problems are known to exist in areas served by on-site systems, although temporary repairs of systems may be required until municipal sewer service becomes available.

In addition, there are several scattered individual disposal systems within areas currently serviced by trunk sewer facilities.

In January of 2000 the City of Woodbury turned administrative responsibility for septic systems over to Washington County. A copy of the Council letter and subsequent ordinance that accomplished this is included in Appendix 11-7. The transfer of authority was conducted under the premise that Washington County is better equipped to keep abreast of evolving regulation regarding septic systems.

11.12 Summary and Recommendations

The Year 2000 Woodbury Comprehensive Sewer Policy Plan is intended to serve as an overall guide for the economical completion of the City's trunk sanitary sewer system. The report is also intended to meet the Metropolitan Council's requirements for sewer planning as set forth in the Council's Local Planning Handbook (May 1997).

The City of Woodbury was divided into seven major districts with each district then being divided into sub-districts. The areas of various land use categories and residential units within each sub-district are presented in Appendix 11-1. Unit wastewater rates were assigned to each land use category. The resultant flows are presented in Appendix 11-2.

Figure 10 shows the proposed trunk sanitary sewer system for the City of Woodbury. This map shows major districts and sub-districts, existing and proposed trunk sanitary sewers with pipe sizes and directions of flow, and lift stations and force mains. Reference points are provided along each line, and point by point flows and point by point capacities are presented in Appendices 11-3 and 11-4, respectively. Appendix 11-5 presents cost estimates for future trunk pipe construction. Appendix 11-6 includes lift station design data and cost estimates. Adjustments in routing and size of the trunk facilities can be expected as determined by the conditions at the time of final design. However, the general concepts should be adhered to for assurance of an economical and adequate ultimate system.

The estimated cost of completion of the entire trunk system as shown on Figure 10 is approximately $12,665,000. Lateral benefit reduces this cost by an estimated $921,000, which leaves the City a trunk completion cost of $11,744,000. The equivalent area charge guidelines presented within this report will allow sufficient income to finance the trunk sanitary sewer system. A capital improvement program for trunk sanitary sewer construction is included in the Cost Analysis Section.

The following recommendations are presented for the Council's consideration:

1. That the Council adopt this report as the Comprehensive Sewer Policy Plan for the City of Woodbury and that it be submitted to the Metropolitan Council, the Metropolitan Council Environmental Services, and neighboring communities for review and comments.

2. That the current policy of assessing for trunk sanitary sewer service on an area and connection basis be retained. This report recommends revision to the current area charges. Generally, area charges should be updated annually based on the ENR Index for construction costs.

3. That the Capital Improvement Program as outlined herein be adopted.

4. That the existing provisions be maintained for controlling Infiltration/Inflow into the sanitary sewer system during new sewer construction.