

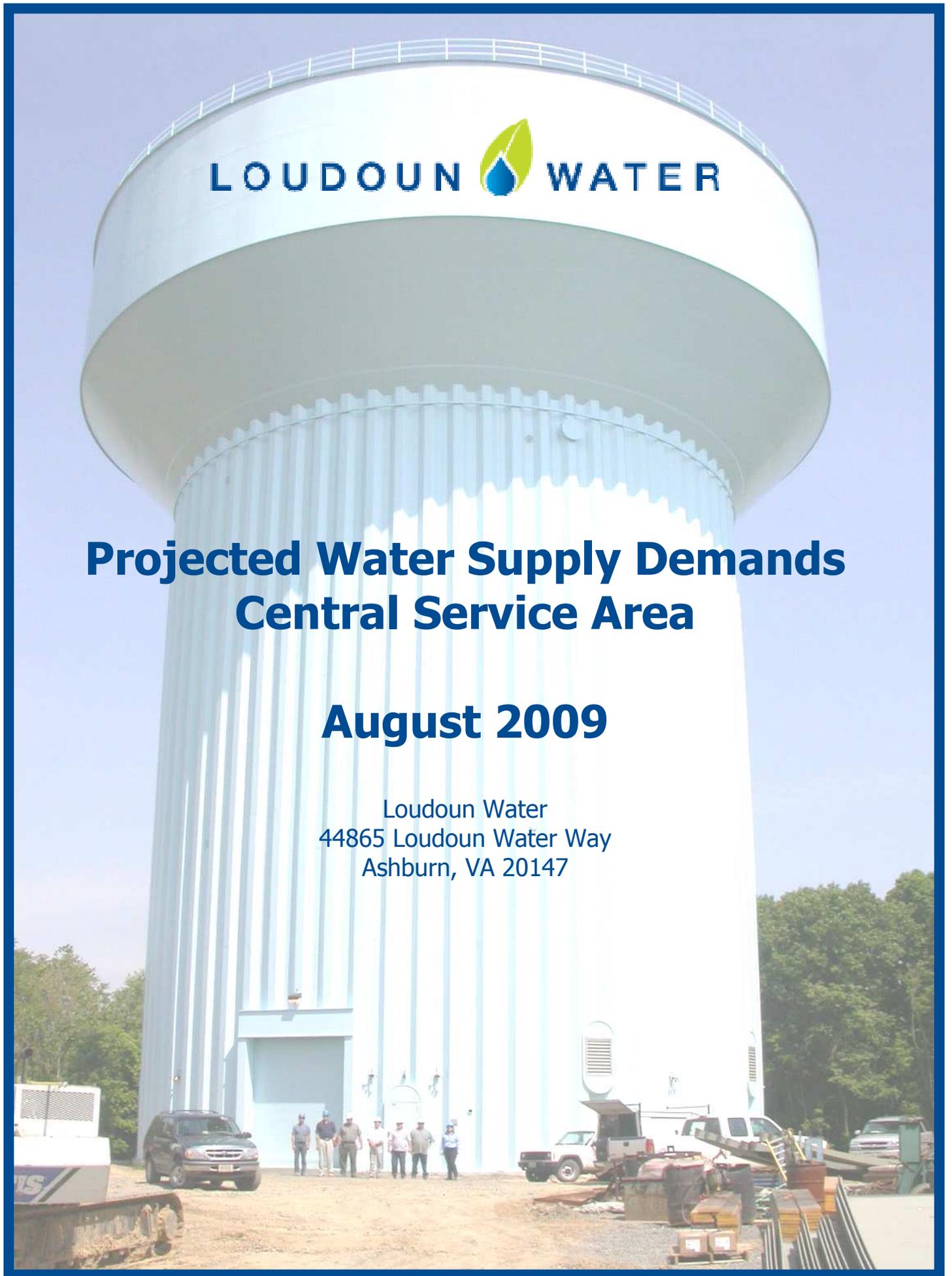


LOUDOUN WATER

Projected Water Supply Demands Central Service Area

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1. Introduction

Loudoun Water is a water and sewer authority serving the eastern portion of Loudoun County. In 1959, the Loudoun County Board of Supervisors created Loudoun Water by a resolution, for the sole purpose of providing water and wastewater service to residents of the unincorporated areas of Loudoun County.

Loudoun County has been and continues to be one of the fastest growing areas in the country as reported by the U.S. Census Bureau. Growth began in the early 1960's with the construction of Dulles International Airport. The growth has continued and between 2000 and 2008 Loudoun's population increased by nearly 65 percent. In August 2009, Loudoun County ranked fourth on CNNMoney.com's top 25 list of counties that have experienced the most job growth over the last eight years. According to the study, from 2000 to 2008 the county's job growth rate increased 76 percent. It is the second year in a row that Loudoun has come in fourth on the list.

Approximately 65 percent of the county's residents are Loudoun Water customers and approximately 82 percent of the county's employment is served by Loudoun Water. Loudoun Water works closely with the planning and development programs within the county government to keep updated on the status of major issues and projects that impact the public water supply. For example, Loudoun Water is aware that the county has already approved future development that will exceed Loudoun Water's current water supply agreements. Also, the county's demographer conducted a workshop with Loudoun Water in October 2008 to discuss the most recent demographic projections and review the overall projection methodology.

Due to planned growth within the county, Loudoun Water has determined that its current water supply agreements will be insufficient to satisfy future water demands. Loudoun Water is presently developing a long-term water management strategy to meet the future needs of its customers in a reliable and sustainable manner.

Projected Water Supply Demands



This study presents an analysis of the demographic and demand forecasts used to quantify the future water demand requirements. This study will:

- Present the water demand projections used as the basis for the long-term water management strategy,
- Demonstrate that the methodology used to develop the projections is reasonable and based on best available information,
- Illustrate the thorough process used to develop local demographic forecasts that form the basis of the demand projections.

2. Background

Loudoun Water provides public water service to residents of the unincorporated areas of Loudoun County; generally consisting of the suburban areas in the eastern portion of the county. As of 2008, Loudoun Water served approximately 180,000 residents and 120,000 employees through 58,000 connections, both residential (55,000) and commercial (3,000).

Loudoun Water also supports many *Community Systems*, which are self-sustaining communal wells and treatment facilities located in other more rural portions of the county. The suburban area served by Loudoun Water is referred to as the *Central Service Area* and is the subject of this study. *Community Systems* are not connected to the central water distribution system and therefore are not addressed in this study.

2.1 Service Area

Loudoun County's Comprehensive Plan was adopted by the county to guide land use development decisions and to establish the basis for amendments to zoning and subdivision ordinances. The Comprehensive Plan was last updated by the county in 2001 and within it, the Revised General Plan (amended through 2007) designates the areas within the county available for public water and sewer service- to be provided by Loudoun Water.

The county is divided into five different geographic policy areas each with preferred development patterns. Figure 2.1 is a map of the county showing the limits of each policy area (Rural, Suburban, Transition, Town JLMA, and Town/Airport).

The Suburban and Transition Policy Areas are designated by the county for public water and sewer service. As such, the boundary of the *Central Service Area* coincides with the limits of the Suburban and Transition Policy Areas. Loudoun Water's *Central Service Area* is shown in Figure 2.2.

Loudoun Water's central water distribution system currently consists of approximately 950 miles of water mains, four booster pumping stations and five water storage tanks.

Projected Water Supply Demands



Two new water storage tanks and a booster pumping station are under construction and are planned to be added to the distribution system by 2011.

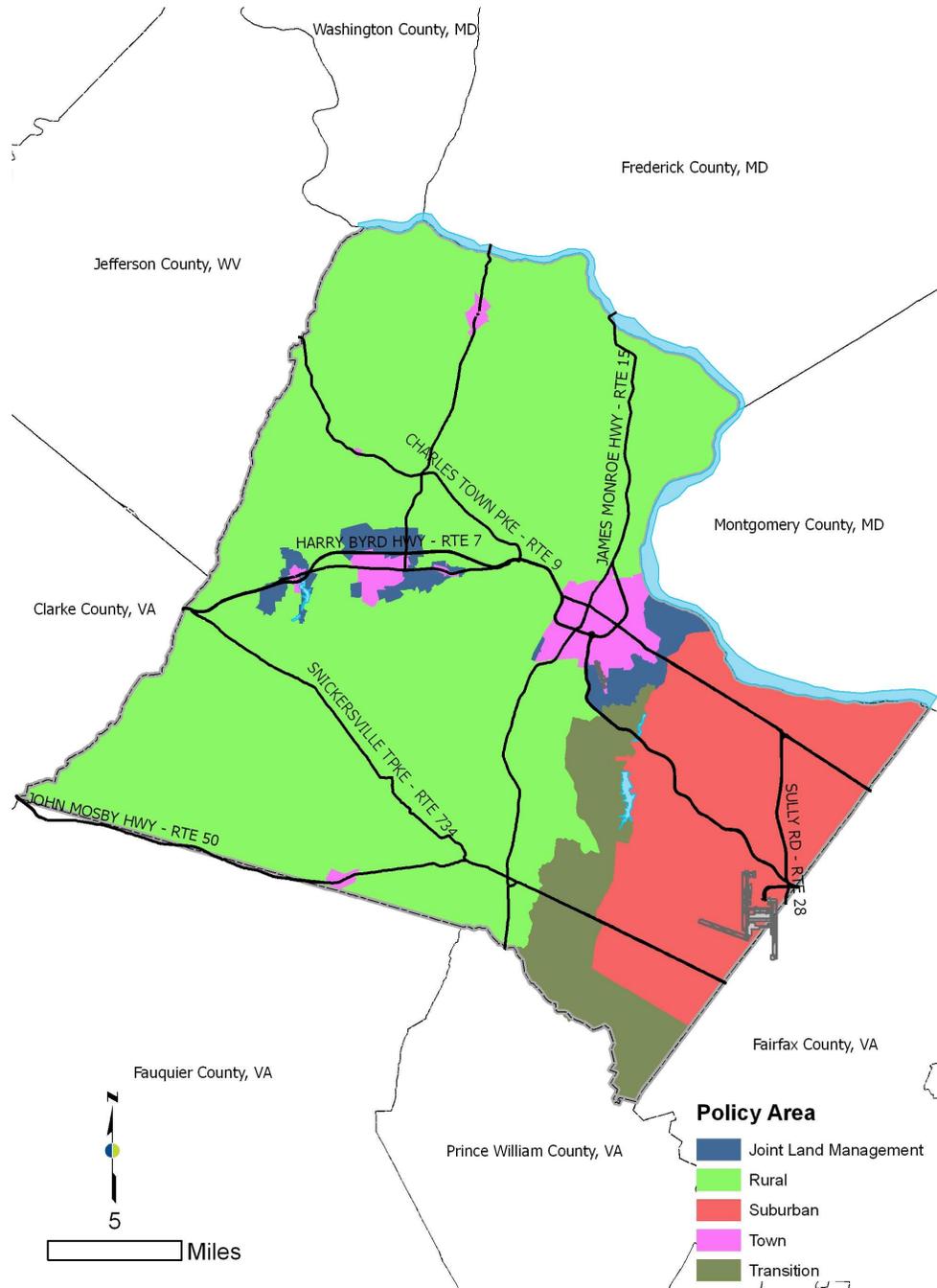


Figure 2.1, Loudoun County Policy Areas

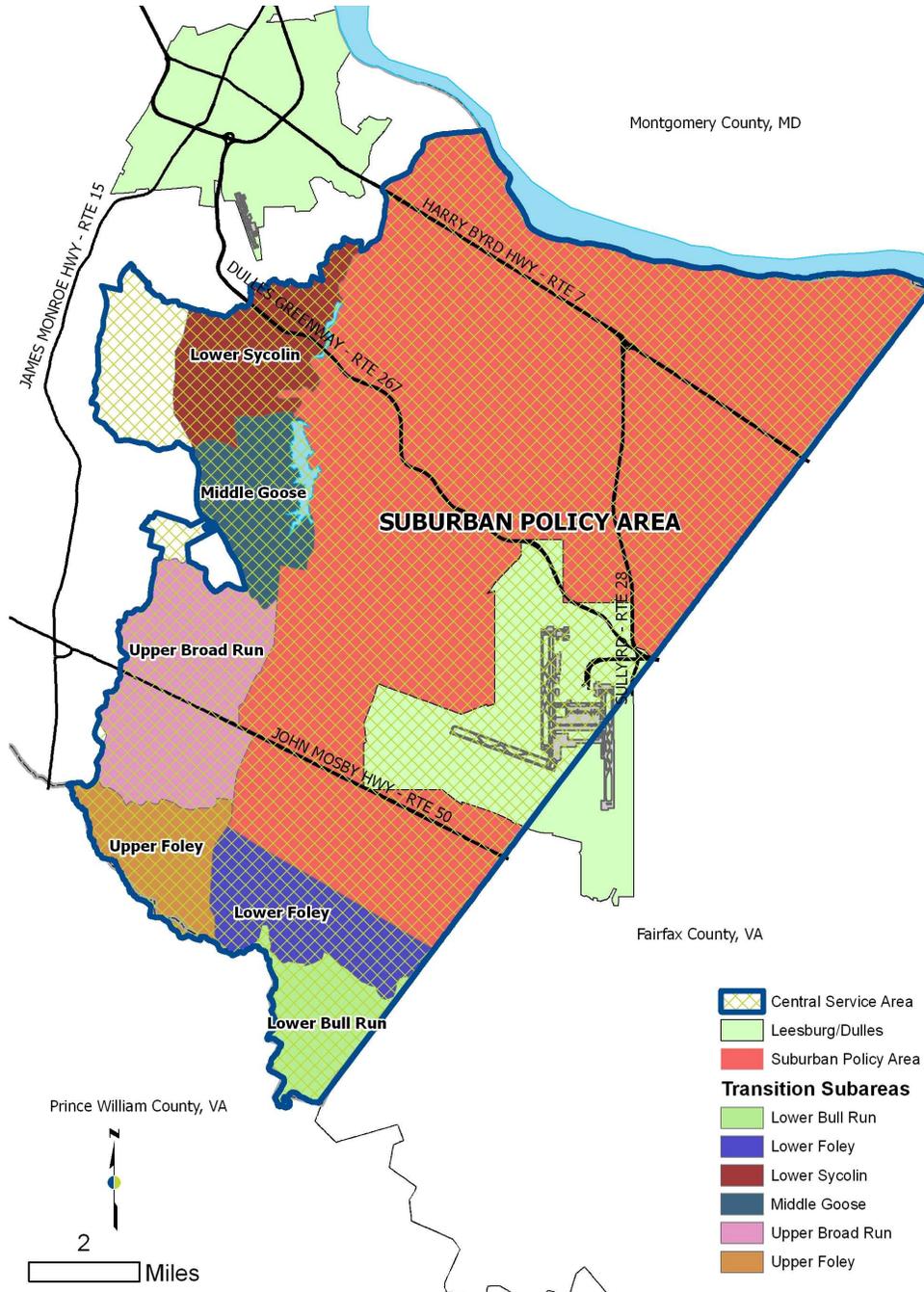


Figure 2.2, Loudoun Water *Central Service Area*

As the population in Loudoun County continues to grow and expand in accordance with the county Revised General Plan, additional water capacity and storage is necessary to provide adequate water supply to the region in times of drought. Due to the length of time needed for permitting, design, construction and to secure financial capital needed to develop these resources, it is necessary to plan water supply projects well in advance of actual need. Instrumental in this planning is Loudoun Water's utility system master planning, which began with the development of a water system master plan in 1989. The water master plan has been regularly updated on 5-10 year intervals since it was developed. Updates have been coordinated with the county's demographic projections consistent with the Comprehensive Plan. The most recent version of the master plan was finalized in 2002 when Loudoun Water had an estimated 33,000 connections serving approximately 130,000 residents and 90,000 employees. The water master plan is currently being updated and the update is scheduled to be completed in 2009. Along with the master plan, Loudoun Water integrates the use of comprehensive computerized hydraulic models and an extensive Geographic Information System (GIS) as effective planning tools.

2.2 Existing Water Supply Sources

Currently, water is supplied to Loudoun Water by Fairfax Water and the City of Fairfax, from the Goose Creek WTP. Loudoun Water has purchased an allocation of 50 million gallons per day (MGD) from Fairfax Water and has "excess" water available from the Goose Creek WTP; however the City of Fairfax system can only provide up to 3 MGD on a consistent basis. An illustration showing the points of supply, and major water facilities in the *Central Service Area* are shown in Figure 2.3.

The water received from Fairfax Water is delivered through the Woodstone Vault near Route 7 in the north and at the Route 50 Booster Pumping Station (BPS) near the county line just south of the Dulles International Airport. Most of the water delivered at these two connections is withdrawn from the Potomac River and treated at the Fairfax Water Corbalis WTP. The connection to the City of Fairfax system is through a vault at the Goose Creek WTP along Belmont Ridge Road (Route 659) and as mentioned, the system can only provide up to 3 MGD on a consistent basis.

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Since Loudoun Water purchases all of its treated water supply from neighboring utilities, it does not own nor operate a major water treatment facility. A representation of the major transmission lines used to move water through the *Central Service Area* is shown in Figure 2.3. The system consists of two major pressure zones and a third, higher pressure zone is planned in the western areas. Water pressure is maintained by pumping and by storage tanks in each zone. Most of the system storage is located in the higher pressure zones and can be fed back to the lower zones.

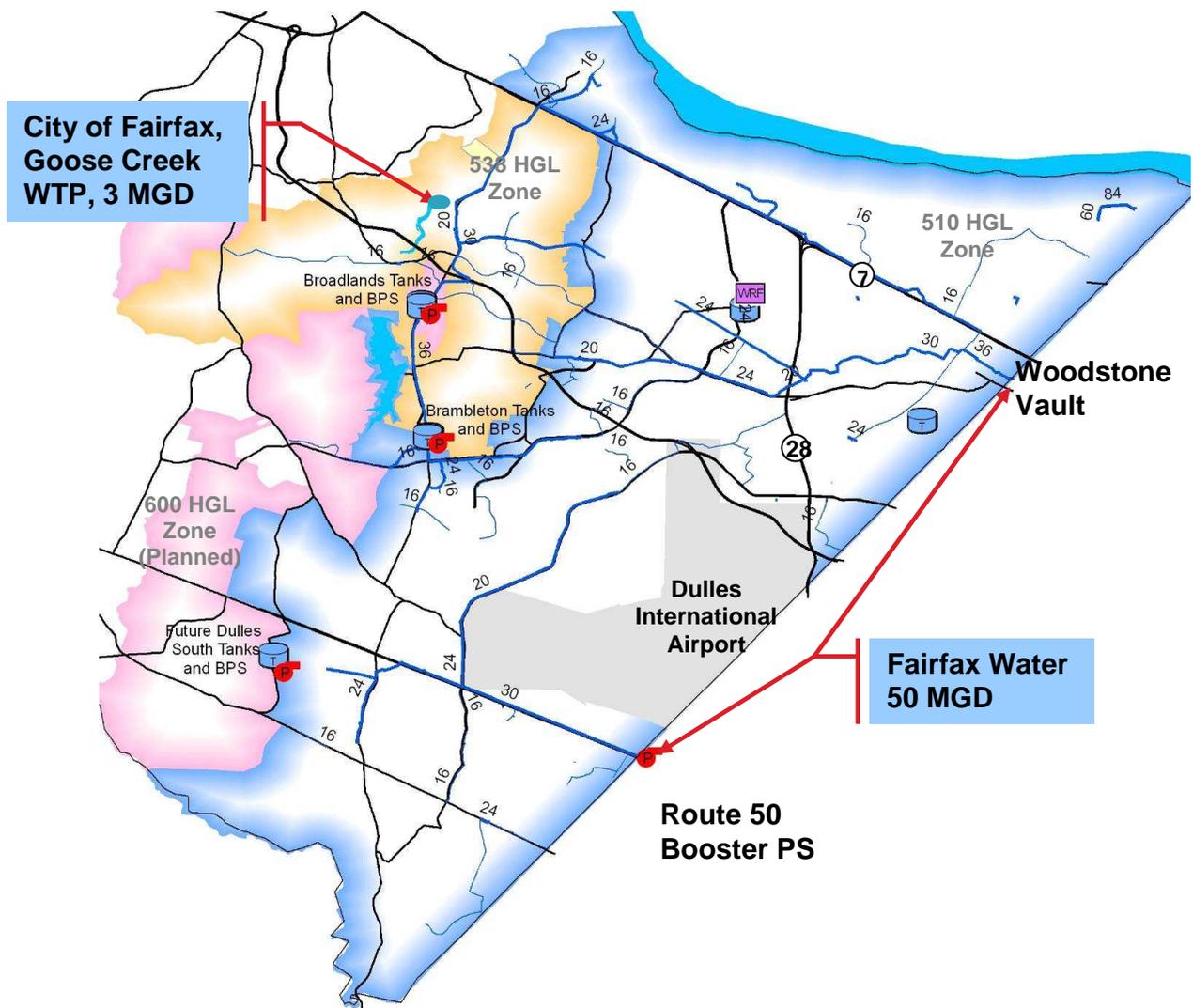


Figure 2.3, Loudoun Water Central Service Area
Points of Supply and Major Facilities

3. Demographic Projections

Loudoun County is the fifth fastest-growing county in the country so far this decade, according to U.S. Census Bureau. Furthermore, Loudoun County accounted for about 18 percent of Virginia's population growth in 2006/2007, according to the U.S. Census Bureau. Loudoun Water serves 65 percent of the county's residents and 82 percent of the employment. To gauge growth, Loudoun Water coordinates closely with county staff and relies on demographic projections developed locally through the Loudoun County Department of Management & Financial Services. The county regularly prepares and updates forecasts, including annual updates for the Fiscal Impact Committee Guidelines and the Annual Growth Summary.

3.1 Cooperative Forecasting and Local Projections

Loudoun County is a member of the Metropolitan Washington Council of Governments (COG) and participates in the regional Cooperative Forecasting Program. The Cooperative Forecasting process is a multi-stage, "top-down/bottom-up" process utilizing a regional model and local jurisdictional forecasts. The model projects employment, population, and households for the metropolitan Washington area based on national economic trends and local demographic factors. Each series of forecasts typically covers a period of 20 to 30 years.

Loudoun County and other member jurisdictions develop local projections based on development, market conditions, planned transportation improvements and adopted zoning and land use plans. A COG subcommittee comprising local government planners, economists, and demographers then reviews and reconciles the two sets of projections. Once the forecasts are reconciled they are presented and approved ultimately by the COG Board of Directors for regional and local use. The forecasts may be adjusted annually to reflect local changes as necessary.

Loudoun Water uses these forecasts for water supply master planning.

3.2 Loudoun County Demographic Forecasting

Loudoun County prepares local demographic forecasts using a “top-down/bottom-up” approach, beginning the top-down process with forecasts for the entire county. Once acceptable overall forecasts are complete, they are apportioned among the county’s ten planning sub areas to provide a more focused estimate. These forecasts are coordinated with COG and other jurisdictions as part of the cooperative process.

The bottom-up approach begins with forecasts keyed geographically to areas referred to as Traffic Analysis Zones (TAZ’s); the county is divided into 126 TAZ’s with an average size of 4.1 square miles each. A base population is established in each TAZ using census data; most recently the 2000 census has been referenced. By tracking the number of building permits issued annually in each TAZ, the county can reasonably estimate the number of houses in each TAZ.

To forecast future development potential, many factors are considered by the county; some typical components considered include:

- current zoning and land use,
- current projects and rezonings in the county system,
- planned land use,
- market conditions and building permitting trends,
- supply of land and residential build out,
- anticipated major improvements to the transportation system.

Taking these as well as other factors into consideration, the county forecasts the number of houses to be built in each TAZ. Then applying conversion factors derived from census data (e.g., 3.2 people per single-family detached house) the county can forecast the residential population in each TAZ. The county does not use a uniform conversion factor for all residences, rather different conversion factors are used for single-family detached, single-family attached (townhouses) and multi-family houses. The forecasts for each TAZ are totaled across the county and compared with the results from the top-down approach.

A similar “top-down/bottom-up” approach is used to derive employment forecasts for the county. Annual employment data is obtained by the county from the Virginia

Employment Commission and supplemented with data from other sources (e.g., Dunn and Bradstreet Business Information Reports) as needed to develop base employment figures. Similar to the residential process, bottom-up employment estimates are developed for each TAZ by tracking the square footage of commercial space permitted annually. Using conversion factors (employees per square foot for occupied spaces) the county forecasts the number of employees for each TAZ. The county does not use a uniform conversion factor for all commercial spaces, rather different conversion factors are used for six classifications of spaces (high density office, low density office, retail, flex/industrial, heavy industrial, and other). Future employment estimates for each TAZ are developed with similar considerations for zoning, land use potential, transportation improvements, etc. as described earlier for the residential forecasts.

The results of the COG and county projections are a series of forecasts, COG refers to them as a “round,” providing land use activity forecasts in five-year increments and typically covering a period of 20 to 30 years.

3.3 Loudoun Water Demographic Forecasting

Loudoun Water relies on the countywide forecasts obtained through COG and the county. The forecasts are used in the planning of the water and wastewater infrastructure for the *Central Service Area*.

The *Central Service Area* consists of 51 TAZ’s averaging approximately three square miles each as shown in Figure 3.1. There are seven TAZ’s that do not lie completely within the *Central Service Area*. For these areas, projections are estimated based on the percentage of the TAZ-area that lies within the *Central Service Area*. Using projections based on the TAZ’s in this manner ensures that the only data used is that which applies to the study area.

Loudoun Water generates demographic forecasts for the *Central Service Area* using the same five-year planning increments and planning period presented in the countywide forecasts. An example of a demographic forecast derived by Loudoun Water for the *Central Service Area* from the COG forecast (Round 7.2) is included in Appendix A. If a forecast is desired for a planning year not included in the projections, the five-year values are interpolated.

Projected Water Supply Demands

For strategic planning initiatives such as utility master plans and water supply, Loudoun Water typically uses the most recent COG "round" forecasts as the basis for projections. However, as explained in the following sections, individual forecasts are considered in context with previous forecasts to develop a wide-ranging and comprehensive assessment of the projections.

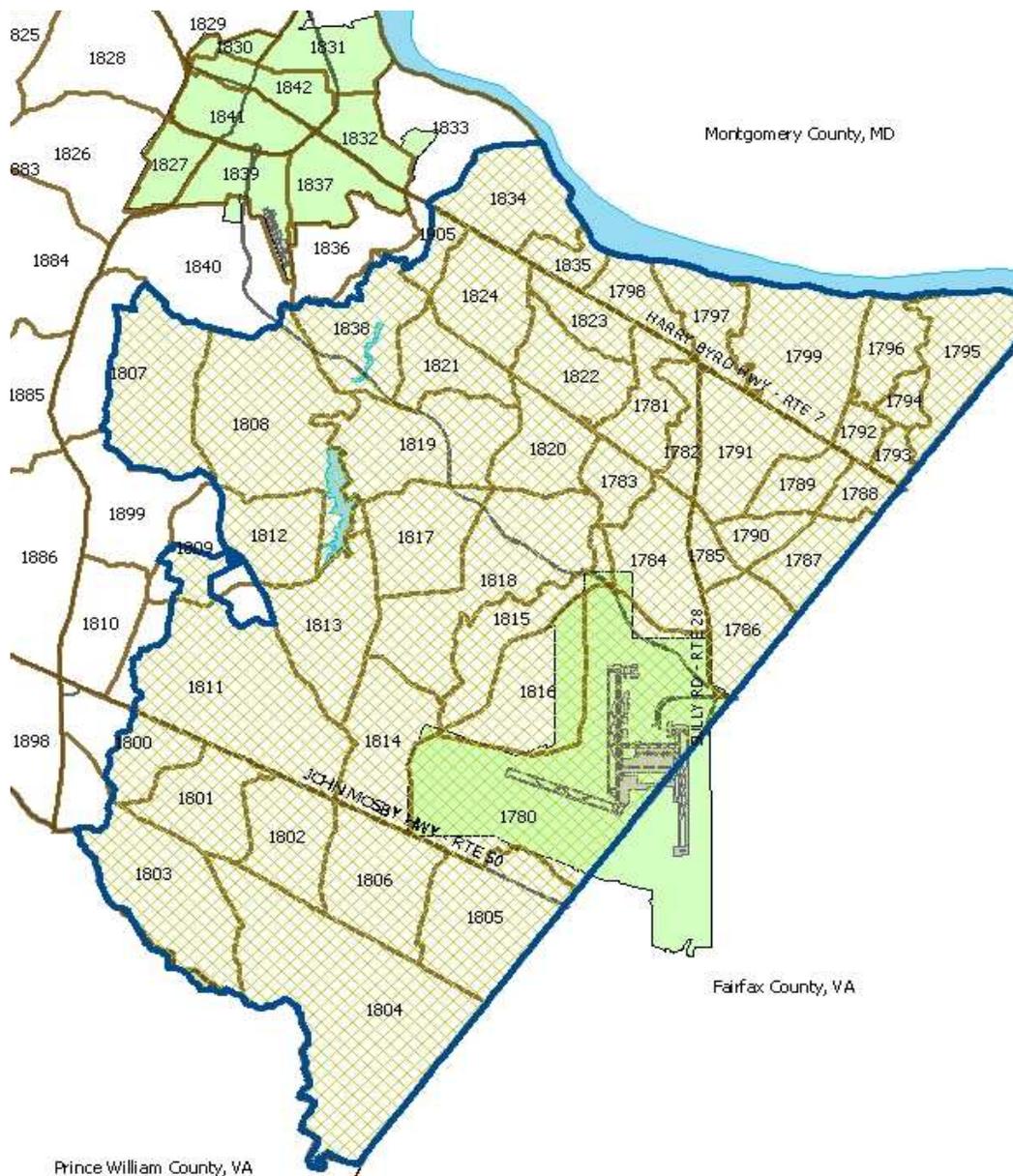


Figure 3.1, Loudoun Water Central Service Area Traffic Analysis Zones (TAZ)

3.4 Recent Demographic Projections

Loudoun Water's contemporary water infrastructure planning began around 1989 with the development of a water master plan. A comprehensive update to the master plan was started in 2000 and completed in early 2002. Prior to the update, Loudoun Water's main service area consisted of two separate distribution systems serving the equivalent of what is currently the Suburban Policy Area. With the completion of the updated master plan, Loudoun Water's contemporary unified *Central Service Area* with multiple pressure zones as shown in Figure 2.3, evolved.

The 2002 water master plan update used the most recent COG forecast (Round 6.2) that was available at the time when planning began. The Round 6.2 forecast extended out to 2025. The countywide forecasts for population and employment were adapted to develop similar projections for the *Central Service Area*. The projections developed for the 2002 utility master plan are summarized in Table 3-1, and are shown graphically in Figure 3.2. The water demand projections associated with these forecasts are discussed in Section 4.

More recently, COG Round 7.1 and 7.2 demographic forecasts were released in January 2008 and June 2009, respectively. These forecasts were developed relatively close together but they have different planning periods. COG Round 7.1 forecasts end in 2030 while the Round 7.2 forecast extends out to 2040. None of these forecasts purport to represent "build out" of growth (nor subsequent water demand) for Loudoun County.

The projections for the *Central Service Area* derived from these COG forecasts are also summarized in Table 3-1, and are shown graphically in Figure 3.2. Likewise, water demand projections associated with these forecasts are discussed in Section 4.

Table 3-1, Recent Demographic Forecasts
Loudoun Water’s *Central Service Area*

	Population										
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
COG 6.2/ Master Plan (2002) ¹	49,316	64,703	107,021	151,420	195,622	237,777	275,027	305,147	--	--	--
COG 6.3 (2003) ¹	--	--	108,541	155,576	193,274	226,728	254,335	272,248	282,919	--	--
COG 7.1 (2008) ²	--	--	--	160,961	200,042	235,271	268,140	282,630	291,661	--	--
COG 7.2/ Master Plan (2009) ²	--	--	108,541	160,995	192,438	217,091	253,994	277,921	286,259	291,363	296,042

	Employment										
	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
COG 6.2/ Master Plan (2002) ¹	25,845	35,618	66,067	94,207	118,170	142,592	167,669	193,919	--	--	--
COG 6.3 (2003) ¹	--	--	67,605	84,987	108,957	128,523	150,902	170,265	195,456	--	--
COG 7.1 (2008) ²	--	--	--	107,410	138,497	168,290	198,648	221,715	237,634	--	--
COG 7.2/ Master Plan (2009) ²	--	--	79,332	107,473	131,682	156,781	186,307	208,367	223,289	236,086	246,958

1. Service area consists of Suburban Policy Area and portion of the Transition Policy Area.
2. Service area consists of Suburban Policy Area and is inclusive of the Transition Policy Area.

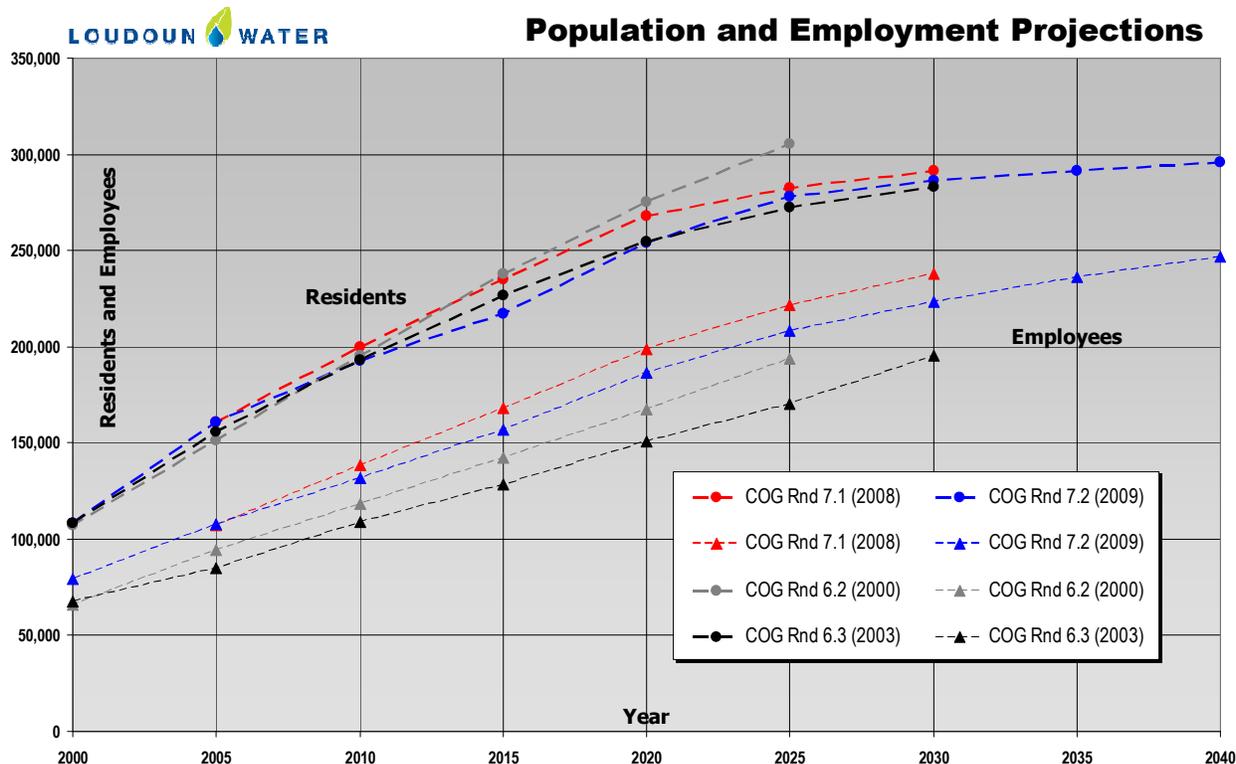
The graph presented in Figure 3.2 represents four recent population forecasts developed for the *Central Service Area*. Upon examination, it is noticeable that the four employment projections between 2010 and 2025 are nearly equal, i.e. the lines are relatively parallel. The four sets of projections increase by a similar amount over the same period and likely represent the same projections shifted in time (horizontally). This may indicate that like assumptions have been applied by COG and Loudoun County throughout these forecasts to develop the employment projections.

The forecasts for residential population do not exhibit comparable patterns, indicating there is more variability in each round of residential forecasts. From 2010-on, each forecast yields a different set of projections with each varying from one another for the most part even in the same planning year.

Projected Water Supply Demands



Figure 3.2, Recent Demographic Forecasts
Loudoun Water's *Central Service Area*



The most recent COG forecast, Round 7.2, indicates that population growth between 2000 and 2010 has been approximately 77 percent and that employment growth for the same period has increased by 66 percent. The growth rate in the first half of the decade was nearly double the rate in the second half.

Table 3-2, Summary of Recent Growth in the *Central Service Area*
COG Round 7.2 (2000-2010)

	2000 to 2005		2005 to 2010		2000 to 2010	
	Increase	Growth Rate	Increase	Growth Rate	Increase	Growth Rate
Population	52,454	48%	31,443	20%	83,897	77%
Employment	28,411	35%	24,209	23%	52,350	66%

Further review of the forecast shows that growth is projected, based on county estimates, to continue over the next 30 years. Over the next 30 years, for the *Central Service Area*, the population is estimated to increase by 54 percent and the employment is expected to nearly double (88 percent increase).

Table 3-3, Summary of Projected Growth in the *Central Service Area*
COG Round 7.2 (2010-2040)

	2010 to 2020		2010 to 2040	
	Increase	Growth Rate	Increase	Growth Rate
Population	61,556	32%	103,604	54%
Employment	54,625	41%	115,276	88%

3.5 Challenges for Loudoun Water – Responsibility to Future Public Water Demand

While the forecasting processes used by COG and the county are comprehensive and thorough, there are many challenges inherent in analyzing and predicting future land development patterns. Any analysis often yields many unknowns for which assumptions must be made. No matter how confidently the assumptions are made, they introduce into the forecasts a degree of variability. Here are some examples.

Trends and Market Conditions

One of the foremost challenges is predicting the timing of development and the subsequent rate of growth for a given timeframe. The forecasts rely in part on historic trends and the anticipation of market conditions to predict when development will likely occur.

The impact of the recent national economic recession that began around January 2008 illustrates the problem with relying on historic trends and market conditions. A comparison of the COG Round 7.1 and 7.2 forecasts shows that the projections for 2010 differed by nearly 7,000 employees (refer to Table 3-1). Yet, the Round 7.1 and 7.2 projections were released in 2008 and 2009 respectively, approximately one year apart and no more than two years before the target date of 2010.

Released in early 2008, the Round 7.1 forecast may not have anticipated the impact of the recession that was beginning. However, prepared over a year later, the Round 7.2 forecast factored in the economic recession and for this reason, projects the employment in 2010 to be five percent lower due to, amongst other factors, the change

Projected Water Supply Demands



in market conditions. It is worth noting that this also demonstrates that growth projections can change over time without any revisions in land use planning or policy.

Another example of variability associated with market conditions is the extension of light rail to Loudoun County as part of the Dulles Metrorail Project. Currently, it is estimated that the rail extension will be completed around 2017. However, large transportation projects of this scale often have fluid schedules and are commonly completed later than originally envisioned. The impact of such a project is the addition of high density development in the *Central Service Area* and accounting for the associated increase in water demand.

The extension of Dulles Metrorail Project to Loudoun County is anticipated to have a marked impact on development in the area, especially around the proposed rail station. The timing of and extent to which development will be influenced are variables that are difficult to predict accurately in the water supply planning stages. The county has included some impacts from the rail project in the recent Round 7.2 forecasts.

Mixed-Use Development

Quantifying the level of development associated with mixed-use structures presents another level of variability. Mixed-use development allows for more than one type of use, most commonly a combination of residential, commercial, or office. These density variables often result in varying water demand increases. This type of development is becoming increasingly popular in the county as it can positively impact traffic, and is more marketable for developers. It can be difficult to project accurately the density to which mixed use structures will be developed, especially in the early phase (planning) when specific development plans do not yet exist. Currently, only the primary use is identified by the county in their estimates and subsequent forecasts. Furthermore, mixed use development is often built in phases and requires predictions of the timing and magnitude of the individual phases. Conservative assumptions about the phased development must often be made during water system planning to assure that the water distribution system and adequate water supply are available as the development proceeds.

Build Out

Build-out projections represent the residential and employment forecasts for growth when all available land has been developed to the extent permitted by the Comprehensive Plan. Build-out projections are not time dependent.

Build out is challenging to quantify at a given time because development is likely to continue beyond the commonly used 20-30 year planning period. When provided, build-out projections do not traditionally include any assumptions for redevelopment potential for given areas. However, builders do not typically achieve the maximum capacity allowed, which increases the potential for future redevelopment, especially in the commercial sector. An *Economic Market Analysis of Eastern Loudoun County* prepared in 2004 by the county Department of Economic Development acknowledges that

"...current development is considerably less than the 0.40 density allowed by the Loudoun County Zoning Ordinance... If the historical density pattern [0.24] continues, Loudoun could expect 40% less square footage than allowed at the derived density."

The analysis quantifies that the impact of the historical versus the allowed density could result in 56.7 million square feet less of office and industrial development in the *Central Service Area*. Conservatively, this equates to nearly 110,000 less employees in eastern Loudoun than if the land were developed to the maximum allowed density. This is another illustration of how forecasts can be affected absent changes in land policies. An increase in development from the historical 0.24 density would result in additional employment without needing a change in land use (rezoning) to achieve; as long as the density remains below 0.40.

These challenges illustrate some of the complexities with forecasting demographics and the inherent variability in the process. The variability is further magnified in Loudoun County considering the recent history of rapid growth and development occurring very dynamically in response to market conditions. Dynamic changes in market conditions can outpace the ability to adjust and revise forecasts as well as plan for and construct water supply facilities.

Projected Water Supply Demands



Nonetheless, the cooperative forecasting process used by the county and other COG member jurisdictions is comprehensive and extensive and produces consistent results. The results are used regionally for planning activities such as determining the demand for schools, parks, medical facilities, roads, etc. The forecasts represent the best available information and are recommended as the basis for planning of public utilities.

To ensure that public utilities are developed reliably, efficiently and cost effectively the systems must be sufficient to meet the needs of the future customer base. It is important to realize, as demonstrated, that forecasting the magnitude and timing of the future customer base must be a continual process whereby the latest available data is frequently checked against other indicators to determine the most appropriate planning horizon. It is for these reasons that Loudoun County, as well as many other local jurisdictions in the region, regularly update, often semi-annually, demographic forecasts.

3.6 Selected Projections for Water Supply Planning

Several recent demographic forecasts derived by Loudoun Water for population and employment in the *Central Service Area* are presented in Figure 3.2. A review of the residential projections shows that the Round 6.2 projections do not follow the same pattern as the other forecast sets. The remaining projections correlate well with each other and indicate a decrease in the rate of residential growth beginning around 2020.

The Round 6.2 forecast was released in 2000 and predates the most recent update to the county's Revised General Plan. The lack of correlation with the other forecasts and that the Round 6.2 projections are not necessarily in-line with the Comprehensive Plan of the county suggests that this data is no longer accurate and should be disregarded. The remaining data sets are well correlated in the outlying years (2025 and beyond) and project similar expectations for the residential population.

Similar review of the employment projections reveals that all of the forecasts are of like shape and slope; the forecasts appear almost linear. The Round 6.2 forecast is disregarded from further analysis for reasons previously mentioned. The most recent Rounds 7.1 and 7.2 forecast greater employment, however since the projections increase by a similar amount over the same period they likely represent the same level

of development shifted in-time. In the outlying years, the employment forecasts do not show the same decrease in the rate of growth as seen in the residential forecasts.

The Round 7.2 forecasts are the most recent available from COG and the county and correlate well with other data. Compared to previous projections, Round 7.2 does not represent the highest or lowest forecast, it falls well within previous estimates. Some impact of the recent economic recession is included in the forecast, which is certain to impact the rate of growth and development, at least in the near future. The Round 7.2 demographic forecast, released by COG in June 2009 will be used as the basis for developing a long-term water management strategy. Furthermore, the forecasts will continue to be reviewed regularly with the latest available data from Loudoun County. The forecast extends the projections out to the planning horizon of 2040.

Table 3-4, Summary of COG Round 7.2 Forecast (2010-2040)
Central Service Area

	2010	2040
Population	192,438	296,042
Employment	131,682	246,958

4. Water Demand Projections

4.1 Historical and Current Water Demands and Trends

The next component in projecting the future water demand at the end of the planning period for the *Central Service Area* is to establish the average daily water usage rates. Once established, the unit rate is then multiplied by the projected population (residents and employees) to determine the future estimated water demand.

For use in master planning, Loudoun Water completed a water demand study in 2002 based on several years of metered billing data. The study reviewed both residential and commercial accounts for multiple regions in the *Central Service Area*. Loudoun Water classifies all non-residential (e.g., retail, office, institutional, industrial, etc.) uses as “commercial.”

The study concluded that the daily average per capita residential water usage ranged from 100 – 115 gallons per capita per day (gpcd) and recommended the use of 100 gpcd for long term planning. The residential unit water demand of “100 gpcd” equates to the recommended value listed in the Virginia Department of Health (VDH) regulations for sizing water treatment plants, storage and distribution systems.

The commercial unit demand was determined in the study to be 70 gallons per employee per day (gped) and was recommended for long-term planning use. The average water usage for “commercial” establishments is difficult to compare as a whole to published standards since usage varies substantially based on the business type (e.g., school, retail, hospital, restaurant, etc.). Though, the recommended planning values of 100 gpcd and 70 gped were found to correlate well with the COG population forecast used at the time.

American Water Works Association

The American Water Works Association's 1999 publication, *Residential End Uses of Water*, indicates that the average residential component for per capita water usage rates in suburbanizing areas is 172 gpcd. This figure does not include water usage by commercial, industrial and institutional users nor unaccounted for water losses. Of the

172 gpcd average water usage rate, 69 gpcd comes from indoor uses, 101 gpcd from outdoor uses, and 2 gpcd from other uses. This study shows the significant impact outdoor water uses can have on average residential water usage rates. In addition, it concludes outdoor water usage rates are higher in warmer climates, and homes with in-ground sprinkler systems use 35 percent more water outdoors than those who do not have an in-ground system. Considering this in the *Central Service Area*, a rapidly suburbanizing area, it can be expected that future residents will use greater than the average residential water usage rates because of the increase in planned residential subdivisions incorporating in-ground irrigation systems. Nonetheless, the planning unit values recommended and used by Loudoun Water for long-term water supply planning are well below those suggested in the AWWA report. Since the recommended values are based on actual customer usage they are preferred over the national figures published in the AWWA report.

Once average daily water usage rates are established, they are applied to the population projections to estimate the annual average daily water demands. Daily water demands vary from day-to-day and all throughout the year. For reliable service, the water system must be capable of meeting the customer demands in the *Central Service Area* on the day of peak usage. Therefore, it is necessary to estimate the demand on the day of peak usage; this is referred to as the annual maximum daily demand. The peak daily usage is typically estimated by applying a multiplying factor (maximum day factor, MDF) to the annual average daily demand.

Recent Actual and Projected Maximum Day Demands

Water master plans developed for Loudoun Water in 1990 and 2002 have been used as the basis for planning the sizing and timing of water infrastructure development in the *Central Service Area*. The master plans project estimated water demands for 25-30 year periods. Figure 4.1 shows the estimated maximum daily water demand as projected by both master plans to the year 2010. Shown alongside the projected values are the maximum daily demands of record for the years 1991-2008.

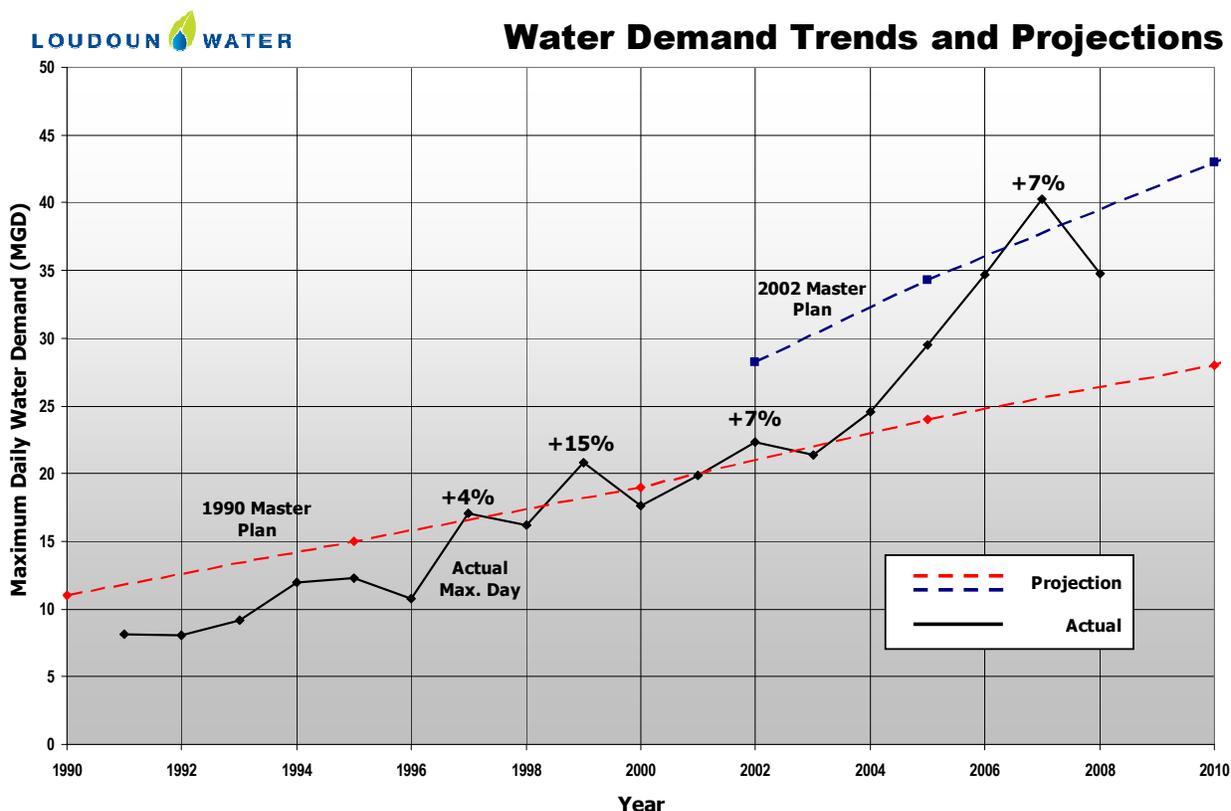
In the past 12 years, Loudoun Water has experienced maximum daily water demands in excess of the projected annual values four times. The magnitude by which the projections were surpassed averages 8.25 percent.

Projected Water Supply Demands



From 1997–2002 the maximum daily demand did not increase steadily from year to year. However, the projected maximum daily demands were exceeded three times in the six year period. The days on which the maximum demand occurred for these years were in the months of July and August. This illustrates that the variability associated with summer water usage patterns has the greatest impact on the maximum daily demands. The variability is further shown in Table 4-1. While the average daily water usage increased (+57%) steadily from 1997-2002 in conjunction with population increase (+57%) the maximum daily demand fluctuated year to year and even decreased in some years.

Figure 4.1, Recent and Actual Projected Maximum Day Demands
Loudoun Water’s Central Service Area



The other occurrence where the maximum daily demand exceeded the projections occurred in 2007 when the demand exceeded the projected value by seven percent. This occurrence was at the end of four years of steady increase in both average and maximum daily demands during a period where the population is estimated to have increased by nearly 25 percent.

Table 4-1, Water Demand Variances from Year to Year
(Compared to Previous year)

	Est. Pop.	Avg. Day	Max. Day		Est. Pop.	Avg. Day	Max. Day
1997	+12%	+19%	+58%	2003	+8%	-2%	-5%
1998	+11%	+12%	-5%	2004	+7%	+19%	+15%
1999	+10%	+12%	+29%	2005	+7%	+18%	+20%
2000	+9%	+03%	-16%	2006	+4%	+5%	+18%
2001	+10%	+14%	+13%	2007	+4%	+14%	+16%
2002	+9%	+7%	+13%				
1997 - 2002	+57%	+57%	+31%	2003-2007	+24%	+69%	+89%

Note: Years shown in **bold** represent years the projected maximum daily demand were exceeded.

The water demand projections in the 1990 master plan were based on a maximum day multiplier (MDF) of 1.75 while the 2002 master plan used a multiplier of 1.85 for the subject period. The 2002 master plan suggested using a maximum day factor of 1.75 for long term planning (2015 and beyond). However, as demonstrated, projections based on the stated multipliers (MDF) used for both master plans were exceeded within five to 12 years after the projections were developed.

Over the last ten years, Loudoun Water has experienced maximum day demands ranging from 1.6 to 2 times greater than the annual average demand. Maximum day demand has been 1.8 times or greater than the annual average for two out of the last three years. Considering this along with the uncertainty of recent projections, it is reasonable that a maximum day factor (MDF) of 1.8 be used for long term water supply planning.

4.2 Demand Projections

The projected annual average daily water demands for the planning period of 2010-2040 are shown in Figure 4.2. These values use the recommended population projections contained in COG Round 7.2 and the recommended average per capita usage rates of 100 gpcd and 70 gped. The projections for maximum day values incorporate a max day factor (MDF) of 1.8.

As demonstrated in Figure 4.1, Loudoun Water experienced demands in excess of past projections that were estimated using similar assumptions. To address the variances

Projected Water Supply Demands



experienced with the maximum daily demands, a confidence interval is applied to the estimated demand projections. The historical variation by which the projections were exceeded is 8.25 percent. It would be reasonable to apply a similar confidence interval to the current projections.

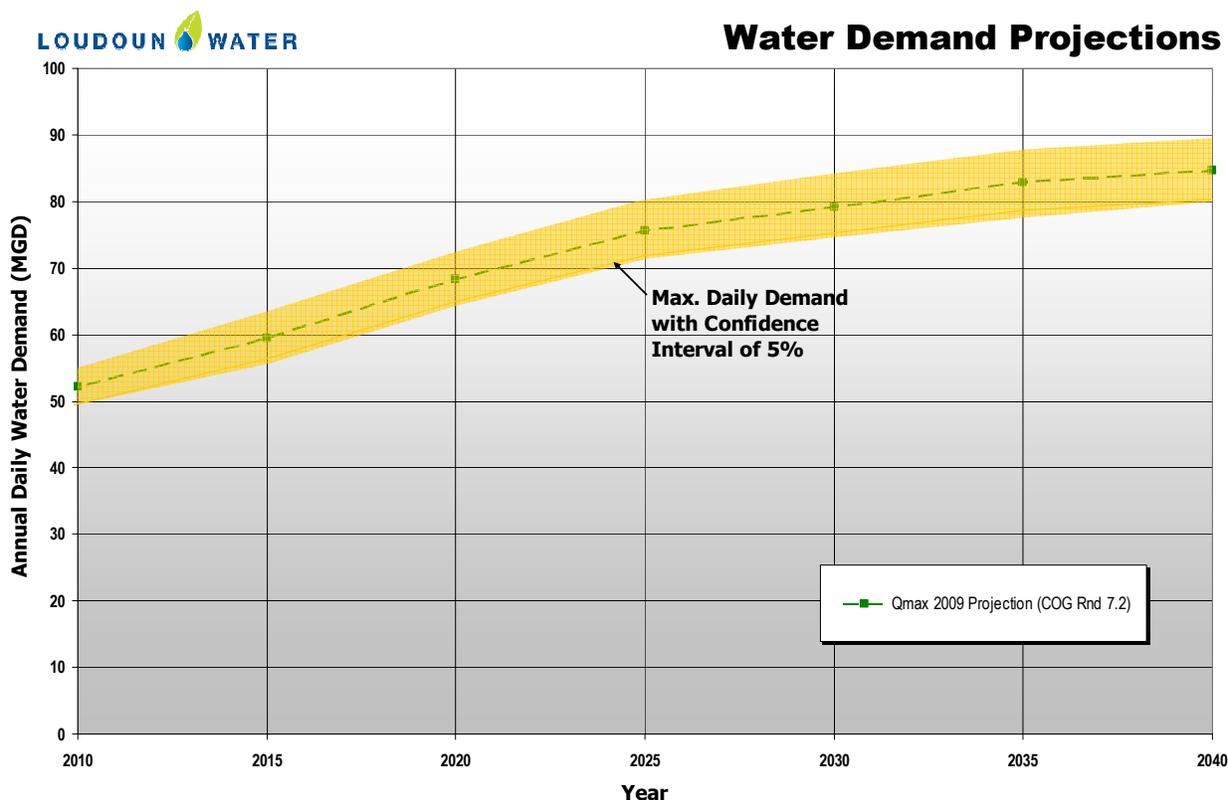
However, in 2008 Loudoun Water had a demand management study performed to analyze water usage patterns and identify possible areas of focus for water conservation. The study concluded conservatively that a water conservation program focused on residential outdoor uses could potentially reduce the future maximum day demands by as much as three million gallons per day. However, the actual impact of any conservation efforts would not be quantifiable for some time- possibly five years after the programs are implemented. Loudoun Water began outreach activities in 2000 to communicate the importance of water conservation to the public.

Considering Loudoun Water's past and future demand management initiatives, it is reasonable to expect some reductions in per capita water demand projections over time. Though the magnitude of any future impact is difficult to project, the conservative estimate derived in the demand management study of three million gallons per day will be applied to the projections. Essentially, this has the effect of reducing the recommended confidence interval applied to the projections from 8.25 to five percent. Figure 4.2 represents the estimated maximum daily water demands projected out to the year 2040.

Projected Water Supply Demands

As the basis for a long-term water management strategy, the estimated maximum daily demand of 90 million gallons per day (2040) should be used for future water demand requirements. This estimate is based on the best information available at this time, and considers all of the variables and factors discussed herein.

Figure 4.2, Projected Maximum Day Demands to 2040
Loudoun Water's *Central Service Area*



**Demographic Forecast for the *Central Service Area*
Based on COG Round 7.2**

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Projected Water Supply Demands



Central Service Area Projections
March 2009

Employment (2000-2040)¹

TAZ ID #	% in Central Service Area	Year									Area (sq. mi.)
		2000	2005	2010	2015	2020	2025	2030	2035	2040	
1780	100%	12,301	14,563	16,059	16,881	17,976	19,082	19,584	20,041	20,473	12.05
1781	100%	1,258	1,257	2,023	2,375	2,759	3,242	3,711	4,236	4,761	1.85
1782	100%	1,616	1,616	2,091	2,637	3,474	4,150	4,774	5,442	6,025	1.04
1783	100%	189	5,460	5,957	6,390	7,043	7,537	7,895	8,135	8,375	1.08
1784	100%	10,342	11,385	12,510	13,119	13,687	14,145	14,530	14,873	15,316	2.79
1785	100%	3,936	3,914	4,480	5,187	5,728	6,280	6,816	7,267	7,713	0.67
1786	100%	5,983	6,565	7,175	8,909	10,899	12,431	13,626	14,699	15,493	1.99
1787	100%	1,848	1,735	1,792	1,815	1,820	1,826	1,841	1,841	1,843	1.56
1788	100%	1,629	1,578	1,613	1,634	1,645	1,659	1,675	1,687	1,700	0.78
1789	100%	1,046	1,107	1,344	1,432	1,505	1,530	1,558	1,569	1,582	1.20
1790	100%	619	491	510	515	518	525	534	542	549	0.94
1791	100%	8,507	12,352	14,696	16,507	18,361	19,541	20,007	20,390	20,597	2.98
1792	100%	241	445	494	513	515	520	527	524	521	0.65
1793	100%	426	665	743	785	800	919	1,055	1,088	1,113	0.50
1794	100%	181	181	193	204	204	207	211	210	210	0.54
1795	100%	678	667	723	747	744	746	748	742	739	3.03
1796	100%	605	408	431	443	433	432	433	428	425	1.57
1797	100%	410	385	413	435	448	476	491	488	487	1.83
1798	100%	1,301	2,264	3,534	4,336	4,765	5,002	5,239	5,466	5,689	1.34
1799	100%	2,604	3,967	4,521	4,676	4,760	4,936	4,926	4,915	4,907	4.18
1800	27%	19	35	57	65	71	83	88	90	91	2.47
1801	100%	69	108	163	175	200	240	252	258	262	2.48
1802	100%	184	787	1,128	1,524	1,709	1,779	1,896	1,930	1,974	2.46
1803	80%	49	83	127	133	139	158	186	203	206	5.38
1804	100%	111	176	250	400	487	534	555	558	560	10.08
1805	100%	1,830	2,262	2,950	3,851	5,624	6,649	7,315	7,792	8,259	4.24
1806	100%	957	1,346	2,492	3,245	3,840	4,150	4,440	4,593	4,671	3.39
1807	60%	19	14	27	36	42	47	51	50	50	6.24
1808	100%	20	18	248	338	363	366	367	367	367	5.99
1809	36%	9	7	14	20	22	25	26	26	26	1.99
1811	86%	393	412	611	1,504	2,811	3,286	3,523	3,699	3,789	7.76
1812	100%	65	63	77	89	95	97	98	97	97	2.22
1813	100%	274	754	1,490	3,047	3,892	4,305	4,645	4,962	5,360	3.42
1814	100%	8	586	821	2,621	5,351	7,928	9,224	10,001	10,433	3.05
1815	100%	2,092	2,141	2,866	3,777	4,625	5,334	6,018	6,737	7,177	2.41
1816	100%	1	750	1,088	1,416	2,192	2,883	3,403	3,907	4,240	3.41
1817	100%	401	585	961	1,346	2,074	2,337	2,399	2,435	2,472	2.93
1818	100%	6,967	7,266	9,770	10,467	14,174	17,156	19,232	21,087	22,949	5.54
1819	100%	1,282	2,322	2,781	3,496	4,158	4,696	5,073	5,387	5,618	4.26
1820	100%	2,991	3,490	4,243	4,914	5,772	6,222	6,442	6,623	6,796	2.10
1821	100%	583	785	1,160	1,341	1,516	1,683	1,813	1,851	1,896	1.95
1822	100%	1,604	2,339	2,578	2,859	3,074	3,195	3,309	3,321	3,340	2.26
1823	100%	785	1,446	1,720	3,997	6,149	7,579	8,457	9,252	9,978	1.25
1824	100%	375	770	1,387	2,661	3,999	5,053	5,833	6,550	7,068	2.59
1833	5%	6	12	13	14	15	15	15	15	15	3.21
1834	100%	2,148	5,418	6,391	7,298	7,967	8,536	8,906	9,285	9,643	2.88
1835	100%	-	2,104	3,862	4,770	5,561	6,259	6,722	7,137	7,552	0.85
1836	100%	187	211	218	255	322	354	377	777	977	2.06
1838	93%	102	101	497	1,012	1,199	1,314	1,416	1,414	1,414	3.12
1899	100%	14	10	12	16	23	26	27	27	27	2.88
1905	100%	68	66	378	555	757	891	1,000	1,071	1,131	1.03
Total Employment		79,332	107,473	131,682	156,781	186,307	208,367	223,289	236,086	246,958	148.5

Notes:

1. Employment projections represent all non-residential for the listed Traffic Analysis Zones (TAZ's), and are based on comprehensive countywide projections prepared by Loudoun County for the MWCOC Cooperative Forecast, Round 7.2 Update.

Projected Water Supply Demands



Central Service Area Projections March 2009

Population (2000-2040)¹

TAZ ID #	% in Central Service Area	Year									Area (sq. mi.)
		2000	2005	2010	2015	2020	2025	2030	2035	2040	
1780	100%	57	57	57	57	57	57	57	57	57	12.05
1781	100%	7	12	387	387	519	519	519	519	519	1.85
1782	100%	-	-	-	-	-	605	1,161	1,492	1,767	1.04
1783	100%	1	1	1	1	1	1	1	1	1	1.08
1784	100%	12	12	12	12	12	12	12	12	12	2.79
1785	100%	749	887	887	887	887	1,406	1,562	1,666	1,666	0.67
1786	100%	661	1,313	1,454	1,610	1,943	3,124	3,786	4,449	5,772	1.99
1787	100%	9,290	9,299	9,299	9,302	9,500	9,500	9,624	9,624	9,624	1.56
1788	100%	5,531	5,542	5,557	5,560	5,563	5,563	5,563	5,563	5,563	0.78
1789	100%	2,109	2,622	2,622	2,622	2,622	2,622	2,622	2,622	2,622	1.20
1790	100%	5,916	5,916	5,922	5,922	5,922	5,922	5,922	5,922	5,922	0.94
1791	100%	3,194	4,334	4,966	5,349	5,763	6,706	7,368	8,030	8,030	2.98
1792	100%	3,863	4,030	4,030	4,204	4,204	4,204	4,204	4,204	4,204	0.65
1793	100%	639	666	675	675	675	675	675	675	1,194	0.50
1794	100%	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	0.54
1795	100%	7,424	9,195	9,692	9,692	9,848	9,974	9,983	9,989	9,995	3.03
1796	100%	8,677	8,686	8,689	8,689	8,689	8,689	8,689	8,689	8,689	1.57
1797	100%	3,125	4,074	4,101	4,117	4,123	4,496	4,524	4,524	4,524	1.83
1798	100%	2,237	3,058	3,064	3,064	3,064	3,064	3,064	3,064	3,064	1.34
1799	100%	13,289	13,915	14,140	14,181	14,190	14,527	14,533	14,539	14,539	4.18
1800	27%	34	237	281	292	309	587	617	626	630	2.47
1801	100%	137	140	140	171	716	1,852	1,908	1,924	1,933	2.48
1802	100%	69	3,406	6,897	10,258	14,044	15,443	15,479	15,479	15,610	2.46
1803	80%	131	153	170	222	329	727	1,557	2,092	2,117	5.38
1804	100%	171	328	1,919	4,294	6,984	8,226	8,600	8,693	8,724	10.08
1805	100%	5,088	9,285	10,847	12,002	13,750	14,409	14,787	15,102	15,102	4.24
1806	100%	1,279	5,955	9,824	11,069	12,741	13,299	13,299	13,299	13,299	3.39
1807	60%	328	434	863	1,141	1,397	1,629	1,777	1,805	1,814	6.24
1808	100%	97	112	1,087	1,367	2,323	2,448	2,523	2,523	2,523	5.99
1809	36%	46	51	187	292	344	378	400	411	411	1.99
1811	86%	275	301	358	962	2,540	4,120	4,440	4,506	4,506	7.76
1812	100%	63	69	514	841	1,028	1,121	1,146	1,146	1,146	2.22
1813	100%	108	2,074	3,935	6,303	11,348	15,340	16,670	17,220	17,350	3.42
1814	100%	139	139	653	2,385	3,533	3,666	3,833	4,280	4,859	3.05
1815	100%	8	332	820	1,339	1,339	1,339	1,339	1,339	1,339	2.41
1816	100%	9	9	9	9	9	9	9	9	9	3.41
1817	100%	58	5,788	8,324	10,035	12,515	13,056	13,056	13,056	13,056	2.93
1818	100%	712	5,296	8,537	10,305	15,991	21,315	23,353	24,592	25,899	5.54
1819	100%	9,565	12,417	12,741	13,412	14,996	15,463	15,463	15,463	15,794	4.26
1820	100%	4,990	5,494	5,497	6,049	6,798	7,046	7,293	7,293	7,293	2.10
1821	100%	6,918	8,788	8,815	8,815	8,815	8,815	8,815	8,815	8,815	1.95
1822	100%	6,803	9,139	12,015	14,996	16,362	16,362	16,362	16,362	16,362	2.26
1823	100%	933	2,408	2,854	3,783	4,923	5,592	5,592	5,592	5,592	1.25
1824	100%	953	5,727	7,326	7,326	7,326	7,326	7,326	7,326	7,326	2.59
1833	5%	105	392	414	454	462	462	462	462	462	3.21
1834	100%	299	6,403	9,106	9,602	10,843	11,440	11,440	11,440	11,440	2.88
1835	100%	-	-	-	-	-	-	-	-	-	0.85
1836	100%	59	86	86	86	86	86	86	86	86	2.06
1838	93%	33	33	250	456	1,913	1,988	2,016	2,016	2,016	3.12
1899	100%	228	258	292	371	527	589	620	642	642	2.88
1905	100%	24	24	24	24	24	24	24	24	24	1.03
Total Population		108,541	160,995	192,438	217,091	253,994	277,921	286,259	291,363	296,042	148.5

Notes:

1. Population projections represent all residences for the listed Traffic Analysis Zones (TAZ's), and are based on comprehensive countywide projections prepared by Loudoun County for the MWCOG Cooperative Forecast, Round 7.2 Update.