9. Water Resources



The future prosperity of Apple Valley depends on wise water management. A sustainable quantity and quality of water resources is an essential part of the City's quality of life, and is vital for growth and development to occur. The Water Resources chapter provides a framework for managing three aspects of the municipal water system:

- Surface Water Management
- Sanitary Sewer
- Water Supply

The Surface Water Management Plan (Page 9-2) serves as a guide for managing the surface water system, including lakes, ponds, wetlands, and the City's stormwater system, which conveys runoff from the landscape to receiving waters downstream. The Sanitary Sewer section (Page 9-7) conforms with the Twin Cities regional 2040 Water Resources Policy Plan, ensuring that Apple Valley will have sufficient wastewater capacity to serve future growth, and that adequate wastewater infrastructure will be available in the locations that are planned for development. This section serves as an inventory of the City's sanitary trunk facilities and a guide for completing the few remaining trunk sewer sections. The Water Supply section (Page 9-20) guides the construction, operation, and maintenance of the municipal water system, so that Apple Valley will have a safe, clean supply of drinking water now and in the future.

Surface Water Management

SWMP Purpose and Scope

The City's 2018-2027 SWMP is the third iteration of the City's SWMP and replaces the previous SWMP adopted by the City in 2008. The purpose of the SWMP is to provide a framework and reference for protecting, preserving, and managing the City surface water resources and stormwater management system. The SWMP is a local water management plan prepared in accordance with Minnesota Statute 103B.235 and Minnesota Rules 8410. According to statute, the purposes of these water management programs are to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with proper management of surface and ground water.

The SWMP was developed consistent with the guidance from the Metropolitan Council, and WMOs with jurisdiction in the City, including the Vermillion River Watershed Joint Powers Organization (VRWJPO) and the Black Dog Watershed Management Organization (BDWMO).

The City's SWMP includes the following content:

- Executive Summary summarizing the significant elements of the SWMP
- Introduction describing the purpose and development of the SWMP
- Land and Water Resources Inventory describing the physical conditions in the City
- Assessment of Issues and Opportunities
- Stormwater System Analysis including water quality and hydrologic and hydraulic modeling
- Goals and Policies
- Implementation Program

Existing System

The SWMP includes an inventory of the surface water resources and stormwater management infrastructure located within the City. The City is subdivided into seven major drainage areas including three drainage areas within the jurisdiction of the BDWMO and four drainage areas within the jurisdiction of the VRWJPO. The City subdivided these drainage areas into subwatersheds for water resource management and planning purposes, including hydrologic, hydraulic, and water quality modeling. The subwatershed divides shown in Figure Figure 4.2 of the Surface Water Management Plan were determined by local topography and the layout of the City's stormwater system. Major elements of the City's stormwater system are also shown in Figure Figure 4.1 of the Surface Water Management Plan, including:

- Location and names of designated stormwater ponds and lakes
- Boundaries of major and minor watersheds
- Stormwater trunk lines connecting the ponding areas
- Forcemains with flow direction and pipe sizes
- Stormwater structure locations
- Locations where stormwater from the City's storm drainage system is discharged to an adjacent community

As part of SWMP development, the City updated hydrologic, hydraulic, and water quality modeling for the majority of the drainage areas in the City. Additional information is included in Section 4 of the SWMP.

Figure 4.2 of the Surface Water Management Plan

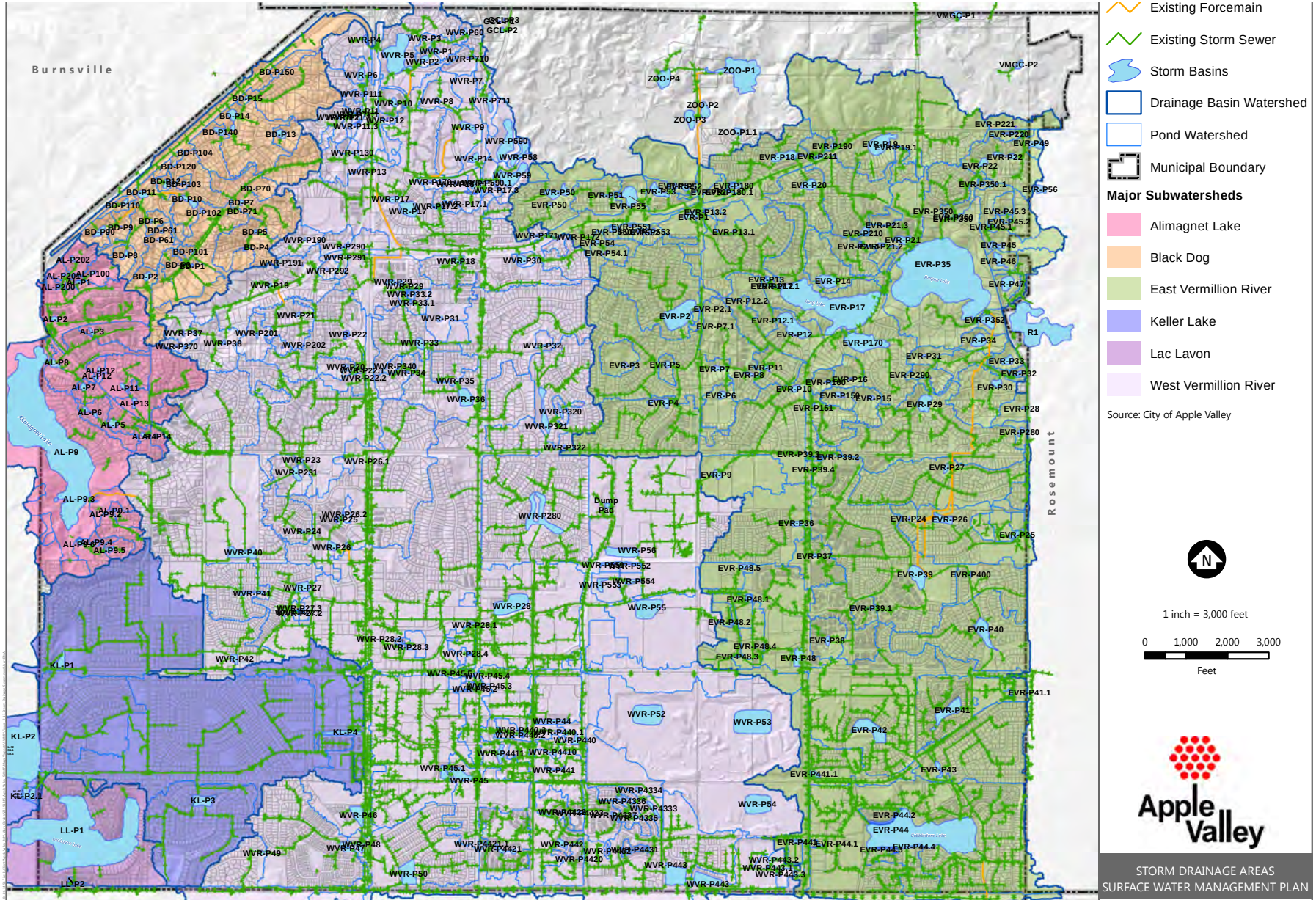
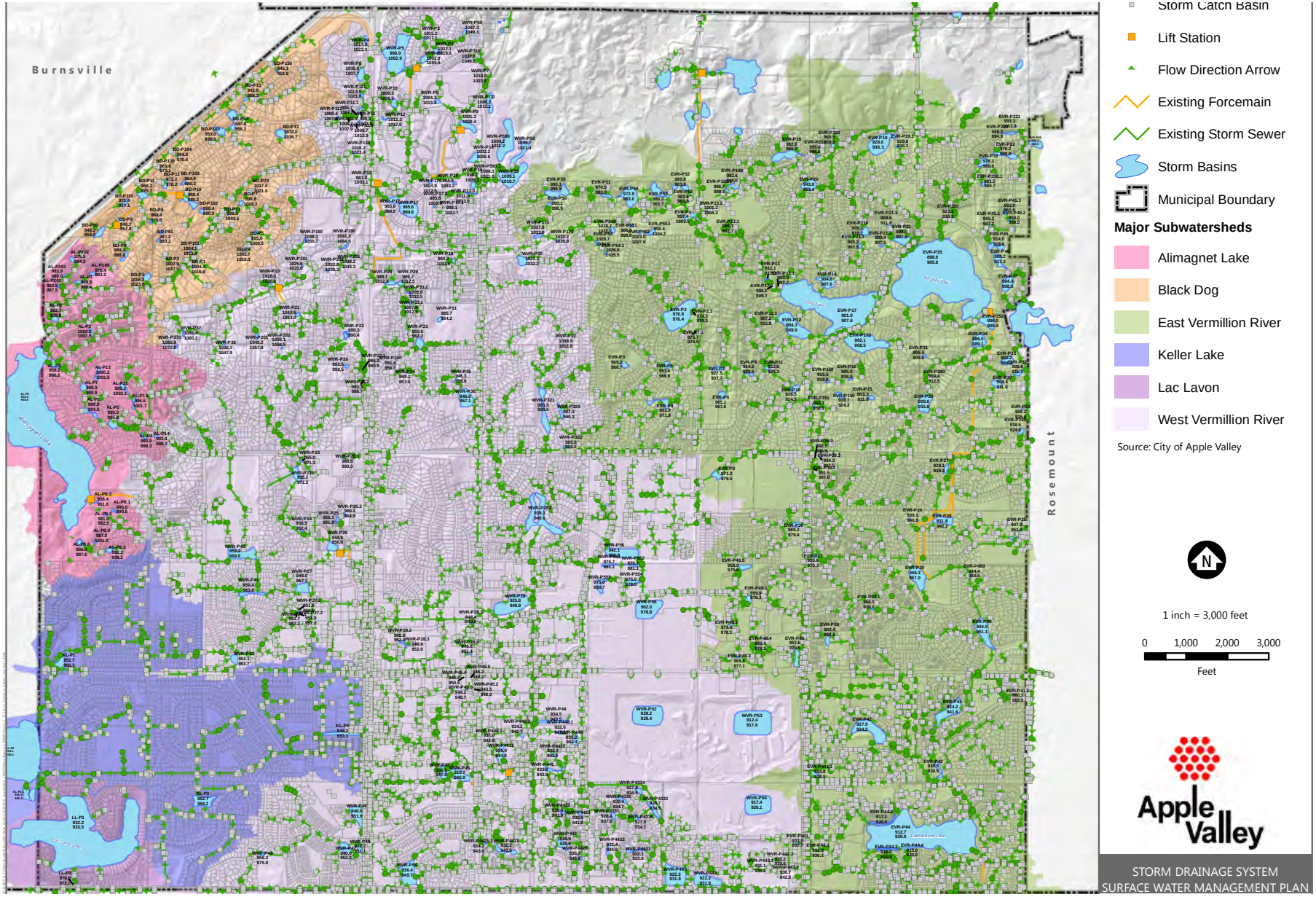


Figure 4.1 of the Surface Water Management Plan



Issues and Opportunities

Section 3 of the SWMP summarizes City-wide and specific water resource issues. The issues discussed in Section 3 of the SWMP are organized into the following topic areas:

- **Water quality** (including stormwater runoff water quality, MPCA impaired waters, total maximum daily load studies, waterbody classification and water quality goals, water quality BMP maintenance, and other water quality issues) – Much of the City's storm drainage planning efforts were made during a time when flood protection was a top priority and the impacts of stormwater runoff on water quality were not fully recognized. Much of the existing water quality degradation is directly related to a largely irreversible stormwater system configuration that routes runoff from urbanized areas through the City's natural water resources. Some of the most challenging issues facing the City include the management of stormwater quality and the water quality of downstream water resources.
- **Water quantity and flood risk reduction** (including floodplain management, hydrologic and hydraulic modeling, and discussion of select local flooding issues) – Many of the most significant historical flooding issues have been addressed by the City. However, development, redevelopment, and changing precipitation patterns place increasing stress on aging stormwater infrastructure. The hydrologic and hydraulic modeling included in the SWMP identified areas where the City will focus its flood risk reduction efforts.
- **Wetland management** (including wetland and shoreland buffers, aquatic invasive species, and wetland classification and inventory) – Diverse wetland systems are critical components of a healthy hydrologic system. Tools to inventory, assess, and regulate wetlands are needed to minimize the negative effects of land development and other human activities in wetlands.
- **Groundwater management** – Consumptive use of groundwater places increased pressure on the bedrock aquifers that the City relies upon for drinking water. In addition, development results in larger impervious areas and more compacted soils, decreasing opportunities for infiltration and recharge.
- **Erosion and sediment control** – Increased sedimentation resulting from urban development may negatively impact water quality, fish and wildlife habitat, and aesthetics. Sediment deposition can also wholly or partially block culverts, manholes, and other stormwater facilities, increasing flood risk and requiring more frequent maintenance of the City's stormwater system.

The issues listed above are described in greater detail in Section 3 of the SWMP. Section 3 of the SWMP also describes opportunities for the City to address these issues. These opportunities, generally, include:

- Cooperation with watershed management organizations (and/or state agencies)
- Partnerships with neighboring cities
- Coordination of stormwater management improvements with redevelopment
- Implementation of low impact development (LID) practices
- Coordination of stormwater management improvements with other City programs (e.g., pavement management, park improvements)

Goals and Policies

The City developed a number of goals and policies to proactively manage stormwater and surface water resources within the City. The goals and policies are designed to continue to improve the quality and effectiveness of water resource planning and management in the City. These goals and policies have been developed to complement county, regional, and state goals, policies and management activities while minimizing redundancy.

The City established the following goals related to stormwater and surface water management:

1. Manage the risk of flooding to minimize adverse effects to life, property, and infrastructure.
2. Manage surface water resources to promote healthy ecosystems, preserve water quality, and meet applicable water quality standards.

3. Manage stormwater runoff to reduce negative impacts to water resources and infrastructure.
4. Protect, restore, and enhance wetlands and natural areas.
5. Protect the quality and quantity of groundwater.
6. Protect water and natural resources through responsible management of development and redevelopment activities.
7. Promote stewardship of water and environmental resources through education, public involvement, and Cooperation.

The policies intended to support these goals are included in their entirety in Section 5 of the SWMP.

Implementation Program

The purpose of the SWMP is to provide a framework and reference for protecting, preserving, and managing the City surface water resources and stormwater management system. An effective implementation program is critical to ensure that the direction provided in the SWMP yields results.

The following sections summarize key elements of the City's surface water and stormwater implementation program (described in greater detail in Section 6 of the SWMP), including:

- NPDES and TMDL requirements
- Stormwater system operation and maintenance
- Education and public involvement
- Ordinances and official controls
- Lake management program
- Projects and capital improvements

NPDES and TMDL Requirements

Under the U.S. Environmental Protection Agency's (EPA) Storm Water National Pollutant Discharge Elimination System (NPDES) Rules, the City of Apple Valley is required to maintain a Municipal Separate Storm Sewer System (MS4) permit for managing point source storm water. In Minnesota, this permit is administered by the Minnesota Pollution Control Agency (MPCA) and has a duration of five years. The City last renewed its MS4 permit in 2013. As part of the permit, the City must also prepare and maintain a Storm Water Pollution Prevention Program (SWPPP) addressing all requirements of the permit.

The SWPPP outlines the appropriate best management practices (BMPs) for the City to implement for controlling or reducing the pollutants in stormwater runoff to the maximum extent practicable. These BMPs are a combination of education, operation and maintenance, control techniques, system design and engineering methods, and other such provisions appropriate to meet the requirements of the NDPES permit. The SWPPP includes BMPs that address each of the six minimum control measures as outlined in the rules:

1. Public education and outreach
2. Public participation/involvement
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management
6. Pollution prevention/good housekeeping

As required by the SWPPP, each year the City must hold a public opportunity to provide input on the adequacy of the MS4 program and the City's SWPPP. The City must also prepare an annual report summarizing the following:

- Compliance with permit conditions, including an assessment of the appropriateness of identified management practices and progress towards achieving identified measurable goals for the six minimum control measures.
- Changes in identified management practices or measurable goals for any of the control measures.

The City's SWPPP also includes BMPs to address waterbodies included on the MPCA's impaired waters 303(d) list for which a total maximum daily load (TMDL) study has been completed. Section 303(d) of the Clean Water Act requires states to adopt water quality standards and identify waters that do not meet these standards. In Minnesota, these responsibilities are administered by the MPCA. Waters that fail to meet state water quality standards are included on the MPCA's impaired waters 303(d) list. The MPCA prepares TMDL studies to address impaired waters. A TMDL is an assessment of the amount of a pollutant that a waterbody can receive and still meet water quality

standards. TMDL studies may result in implementation plans to address water quality issues of the affected waterbodies.

The draft 2018 impaired waters list includes four lakes in Apple Valley:

- Alimagnet Lake
- Farquar Lake
- Keller Lake
- Long Lake
- East Lake (in City of Lakeville, but roughly one-third of our drainage area)

TMDL studies have been completed for all of the impaired lakes listed above. Typically, the City will take the lead to complete and implement TMDLs for waters impaired due to excess nutrients where the watersheds are located wholly within the city. For impaired waters located in the city with inter-community watersheds, the City may request the appropriate watershed management authority lead or co-facilitate the completion and implementation of the TMDL study. For TMDL studies that have regional implications the City will cooperate with lead agencies as appropriate.

Stormwater System Operation and Maintenance

The City of Apple Valley is responsible for maintaining its stormwater system. Proper maintenance will ensure that the stormwater system continues to function as designed and provides the intended benefits. The City's operation and maintenance program is closely tied with the City's implementation of its NPDES MS4 permit and many of the City's maintenance activities are included in the City's SWPPP.

The City's stormwater system includes not only pipes and constructed ponds, but also lakes, wetlands, and other drainage ways. In addition to more typical maintenance measures, maintenance of the stormwater system may also mean maintaining or restoring the ecological characteristics of the natural portions of the stormwater system. The City regularly inspects and maintains key components of the system, including storm sewer and culvert inlets, overflow drainage swales, stormwater ponding and water quality treatment basins, and riprap-protected banks, and storm sewer and culvert outlets. The City of Apple Valley periodically inspects stormwater storage basins and water quality treatment facilities to identify excessive sediment build-up, collected debris, and undesirable vegetation. The City will use inspection data and available modeling results to prioritize pond maintenance needs.

Education and Public Involvement

Education and public involvement serve an important role in enabling the City of Apple Valley to implement its water resource management programs. The City's education and public involvement program is closely tied to implementation of its NPDES MS4 permit; several of the City's education measures are included in the City's SWPPP Generally, the goal of the City's education program is to promote stewardship of water and natural resources through education, public involvement, and cooperation. To achieve this goal, the City performs various education and communication activities. These activities are tailored to a range of target audiences.

The following target audiences for the education program are:

City Staff. City staff must have adequate understanding of water resource issues and the City's SWMP content to effectively carry out the City's stormwater and surface water management responsibilities. It is essential for the success of the program that City staff set a good example to the community's residents, businesses, and customers by demonstrating behaviors that promote watershed stewardship.

City Residents. People who live and do business within the city are affected by the City's water resource management programs. Much of the City is privately owned and maintained. It is important to educate and involve residents and business owners to maintain the political and economic support necessary to implement the SWMP. Communicating the City's roles and responsibilities with respect to these issues is important to manage residents' expectations, discourage behaviors with negative consequences, and develop community capacity for practices that positively impact water resources.

The Development Community. Development and redevelopment activities may have a substantial impact on runoff quality and downstream water bodies during and after construction. Communicating City requirements for land-disturbing activities to developers and their consulting engineers is an important component of the education program.

Ordinances and Official Controls

The City of Apple Valley regulates the management of stormwater and protects water resources through the policies included in its SWMP, City ordinances, the City's project review and permitting program, and other applicable regulatory programs. These are collectively referred to as "official controls."

The City's SWMP and ordinances include requirements for development and redevelopment activities that address the following:

- Stormwater runoff water quality
- Stormwater runoff rate and volume control
- Erosion and sediment control
- Minimum building elevations (relative to adjacent waterbodies)
- Wetland impacts and vegetated buffers

The City requires various permits and/or approvals for land-disturbing projects (including developments), depending on the type of project. The City reviews each proposed activity for consistency with its official controls prior to issuing permits and/or approvals. Consistent with the intent of its official controls, the City encourages infiltration as a preferred method of water quality treatment and volume control, where feasible, either in on-site features or in regional features. These measures will enhance groundwater recharge, decrease the burden on the storm drainage system, and minimize the pollutant loads reaching high priority downstream waterbodies. The City also encourages the use of low impact design (LID) techniques to minimize negative effects of development and redevelopment on stormwater infrastructure and natural resources.

The City of Apple Valley acts as the Local Governmental Unit (LGU) responsible for administering the Wetland Conservation Act (WCA). This includes requiring and verifying that all projects impacting wetlands meet the requirements of the Minnesota WCA and applicable City wetland management guidance.

Standards for protection and enhancement of wetland resources included in the SWMP are prioritized according to their wetland classification, which is based on an assessment of functions and values.

Because all wetlands provide some functional values, all are protected to some degree under provisions in the SWMP.

Regulation of activities that may impact individual wetlands will be based on evaluations of proposed activities, site-specific wetland boundary delineations, and wetland management classifications.

Priority Lake Management

The 2018 SWMP identifies six priority lakes. The City identified priority lakes considering intended recreational uses, existing MPCA impairments, applicability of MPCA water quality standards, and coordination with other city and/or WMO classification systems. City of Apple Valley priority waterbodies include

- Alimagnet Lake
- Cobblestone Lake
- Farquar Lake
- Keller Lake
- Lac Lavon
- Long Lake

The City adopted water quality goals for each lake consistent with state and WMO standards. The SWMP implementation program includes actions to maintain or improve water quality in priority lakes.

The City recognizes lakes as complex systems whose responses to numerous natural and other variables are difficult to predict. Therefore, the City uses an adaptive management approach. The City may modify its planned future actions as necessary based on the results of prior actions, new data, or other factors.

Projects and Capital Improvements

The City performs projects and capital improve-

ments to achieve the water resource management goals outlined in its SWMP. These include non-structural projects (e.g., developing a water quality model, performing feasibility studies) as well as structural improvements (e.g., constructing an infiltration basin). These activities are summarized in implementation tables included in the SWMP.

The City generally performs projects and/or capital improvement projects to maintain the function of its stormwater system, reduce flood risk, and/or improve water quality. In some cases, a technical assessment (or feasibility study) has already been completed to address a known problem and a preferred option is already identified. Other situations may require conducting a feasibility assessment to evaluate options to address a known problem and select a preferred alternative. Finally, a broader pro-active assessment and prioritization of problem areas (e.g., city-wide modeling) may be called for to determine the extent of the issue and assess solutions. In this case, projects may then be prioritized depending on their degree of risk or severity.

With respect to water quality, the City will implement those projects necessary to address TMDLs developed for impaired waters and achieve water quality goals for priority lakes, where most feasible and to the maximum extent practicable. This will include improvements that have already been identified through completed TMDL studies, City lake management plans, or other planning efforts. Additionally, the City will develop lake management plans and implementation programs for remaining priority lakes

The City will continue to rely on its 5-year Capital Improvement Planning process to schedule and plan for funding of capital improvements. This CIP is updated annually by City staff and reviewed and approved annually by the City Council.

The City carries out its implementation program with the intent to achieve the City's goals while promoting efficiency and minimizing cost. Therefore, the City will seek opportunities to coordinate stormwater system repair and/or replacement with its Pavement Management Program, redevelopment opportunities, or other coordinated projects (e.g., park improvements, other utility upgrades). The City may also re-prioritize projects based on the availability of grant funding, cost-share opportunities, or availability of other funding sources that may reduce the City's financial responsibility.

Sanitary Sewer

The Metropolitan Council of Environmental Services (MCES) requires that the City submit a Sanitary Sewer Plan as part of the 2040 comprehensive plan update. The comprehensive plan is updated every ten years. The wastewater plan is reviewed to ensure conformance with the 2040 Water Resources Policy Plan and Thrive MSP 2040 to ensure that the Metropolitan Council's regional wastewater system has adequate capacity to serve the future needs of the region in the right locations at the right times. Conformance for wastewater means that, within the Metropolitan Urban Service Area, communities are meeting the overall density expectations identified in Thrive MSP 2040.

Apple Valley has prepared this section of the Comprehensive Plan to demonstrate its conformance to the regional plan. This section of the Utilities chapter summarizes Apple Valley's Comprehensive Sanitary Sewer Plan (see Appendix) that provides the specific information needed to meet the 2040 requirements. The Comprehensive Sanitary Sewer Plan serves as an inventory of the City's sanitary trunk facilities and a guide for completing the few remaining trunk sections.

Existing Sanitary Sewer System

General

A review of the City's existing sanitary sewer collection system will provide insight into its ability to convey domestic, commercial and industrial wastewater to the wastewater treatment facility. The existing trunk sewer system is mostly complete with the exception of approximately 500 acres within the southeastern part of the City. This area will be developed as the current sand and gravel mining operations cease. The existing collection system was evaluated for its ability to serve this area as well as remaining undeveloped parcels.

Trunk Sewer System, MCES Interceptors and Intercommunity Connections

The City's trunk sanitary sewer system is shown on Figure 9.1. The trunk system consists of gravity lines ten inches in diameter and greater, lift stations and forcemains. The City is divided into five sewer districts, each defining the limits of service for a separate trunk system.

The Southwest, South Central and Southeast Districts are the largest districts and flow leaves Apple Valley to the south through MCES interceptor lines into Lakeville. The remaining two Districts are the Burnsville and Eagan Outlets (2 in each district) which all flow to the north into Burnsville and Eagan respectively. There are no trunk sewers in the Eagan Outlet. This area is only served by sewer laterals and encompass a regional park, zoo, and small residential area.

Wastewater flow leaves Apple Valley at seven different locations at or near the City borders. A list of these locations and their average flows is presented in Table 9.1 These flows all lead from Apple Valley through other municipalities to either the Empire or Seneca WWTPs.

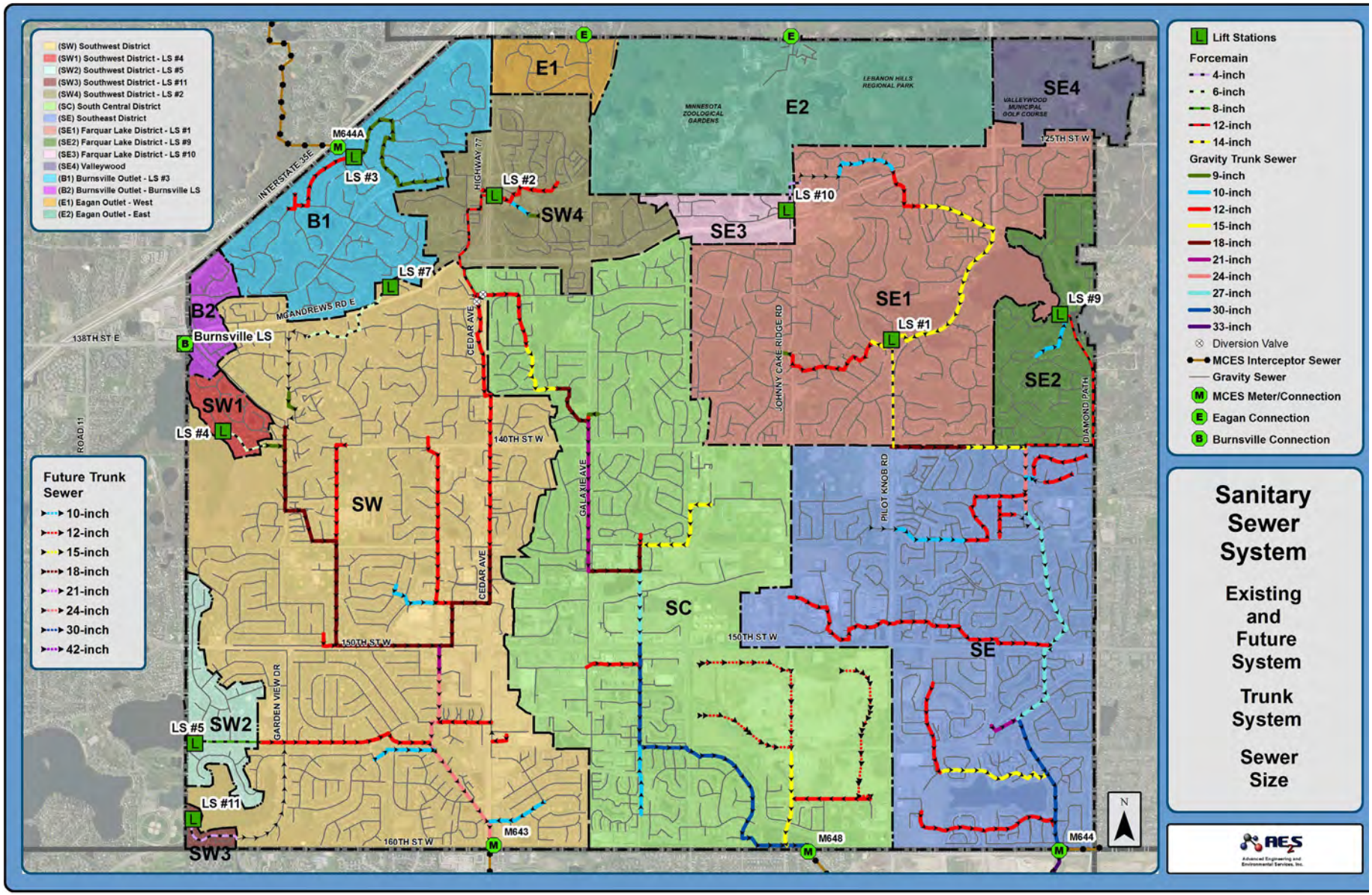
There are approximately 11,181 acres in the City of Apple Valley, of which approximately 487 acres remain to be developed. Of the overall total, 9,400 acres are served by the MCES Empire wastewater treatment plant (WWTP) located near Pilot Knob Road, 197th Street East and the Vermillion River, in Section 21 of Empire Township. Conveyance to the Empire WWTP is provided by the MCES Interceptor mains beginning at meters M643, M648, and M644.

Wastewater from approximately 1,800 acres in the northern portion of Apple Valley is served by the MCES Seneca WWTP located near Comanche Road and State Highway 13 in Section 21 in Eagan. Conveyance to the Seneca plant is provided by the MCES Interceptor main from meter M644A and trunk sewers in the City of Eagan and Burnsville.

Table 9.1 Intercommunity Flows

District	From	To	Average Estimated Flow (MGD)
Southwest (SW)	SW, SW1, SW2, SW3, SW4	MCES M643	1.47
South-Central (SC)	SC	MCES M648	0.87
Southeast (SE)	SE, SE1, SE2, SE3, SE4	MCES M644	1.06
Burnsville Outlet	B1	MCES M644A	0.15
Burnsville Outlet	B2	Burnsville	0.02
Eagan Outlet	E1	Eagan	0.02
Eagan Outlet	E2	Eagan	0.10

Figure 9.1, Sanitary Sewer System



Lift Stations

The City's sanitary sewer system consists of 9 lift stations ranging in size from a 100 gallon per minute (gpm) to a 2200 gpm lift station. The lift stations have been sized to handle buildout of their respective service areas. Table 9.2 summarizes the capacity information for each of the lift stations. The locations of the lift stations are shown on Figure 9.1.

Table 9.2 Lift Station Capacities

Lift Station No.	Present Capacity (MGD)	Ultimate Capacity (MGD)	Force Main Size (inches) Capacity in GPM
LS 1	3.16	3.16	14
LS 2	2.016	2.016	12
LS 3	0.936	0.936	8
LS 4	0.288	0.288	6
LS 5	0.6	0.6	6 and 8
LS 7	0.288	0.288	6
LS 9	1.915	1.915	12
LS 10	0.216	0.216	4
LS 11	0.144	0.144	4

Large Sewer Users

At the present time, there are no major industries in Apple Valley whose average daily sewage flow exceeds 50,000 gallons. At this time, no industries in the City require pretreatment of their wastewater before discharge into the City's system.

Existing Wastewater Flows

The total flows are measured by MCES at 4 meter locations leaving the City. Annual, monthly, and hourly flow data is available for the MCES meters. Peak month and peak hourly flow data help determine infiltration and inflow contributions.

The 10-year average annual per capita wastewater flow is approximately 66 gallons per day (GPD) and the average dry weather (winter) per capita wastewater flow is approximately 66 GPD. Water use data is available by customer type and can be used to estimate the breakdown of wastewater flow between residential and other land uses. Water use data indicates that winter residential water use averaged 85% of the total water use over the last 10 years; thus the residential portion of the average per capita wastewater flow is approximately 56 GPD (85% of 66). When comparing 10-year average dry weather flows to the same winter quarter water usage, the wastewater flow is approximately 97% of the water use. The metered dry weather wastewater flow correlates quite well with the metered water use for the same time period, which indicates some validity to the existing flow data.

Population and Employment Forecasts

The comprehensive wastewater plan is developed in part to portray the condition of the Apple Valley wastewater collection system under future flow conditions assuming that the population and employment forecasts are achieved. The purpose in developing the future plan is to anticipate future changes to the system that may be required and to allow for the development of a sustainable capital improvements program for the wastewater collection system. The Thrive MSP 2040 population, household and employment forecasts (Table 9.3) in 10 year increments through 2040 were used in generating wastewater flow projections and in maintaining the required consistency with all parts of the comprehensive planning effort.

Table 9.3 Metropolitan Council Projections

Forecast Year	Population	Households	Employment
2010	46,084	18,875	14,279
2020	55,500	21,700	15,800
2030	59,200	23,300	16,400
2040	63,600	24,900	17,100

Table 9.4 presents the projections broken down according to sewered and unsewered components.

Table 9.4 Metropolitan Council Projections (Sewered & Unsewered)

Forecast Year	Component	Population	Households	Employment
2010	MCES Sewered	46,686	17,928	13,714
2010	Unsewered	2,398	947	565
2020	MCES Sewered	59,980	21,500	15,680
2020	Unsewered	520	200	120
2030	MCES Sewered	59,170	23,280	16,400
2030	Unsewered	30	20	0
2040	MCES Sewered	63,520	24,880	17,100
2040	Unsewered	80	20	0

Ref: Metropolitan Council Thrive 2040 Water Resources Policy Plan May 2015

Tables 9.5 and 9.6 present projections of sewered population, households and employees for the portions of the City served by the Empire and Seneca WWTPs, respectively, as prepared by MCES and presented in its Thrive 2040 Water Resources Policy Plan.

Table 9.5 Projections for Empire WWTP

Year	Population	Households	Employment
2020	50,500	19,700	14,400
2025*	52,500	20,550	14,650
2030	54,500	21,400	14,900
2035*	56,550	22,150	15,150
2040	28,600	22,900	15,400

Ref: Metropolitan Council Thrive 2040 Water Resources Policy Plan May 2015

* Interpolated Values

Table 9.6 Projections for Sceneca WWTP

Year	Population	Households	Employment
2020	4,500	1,800	1,300
2025*	4,600	1,850	1,400
2030	4,700	1,900	1,500
2035*	4,800	1,950	1,600
2040	4,900	2,000	1,700

Ref: Metropolitan Council Thrive 2040 Water Resources Policy Plan May 2015

* Interpolated Values

Sanitary Sewer Flow Projections

General

In an effort to forecast flows for future growth, the land use plan will be utilized. Flow rates will be established for each land use category based upon the anticipated density in units and persons per acre which can be applied to specific undeveloped parcels or redevelopment areas. These unit flow rates can be used to generate average annual flow projections for these specific development areas.

To forecast future flow from existing areas historical flow data, industry standards and current MCES data were used. MCES has indicated that regional data suggests the current overall average annual flow is 85 gallons per capita per day (gpcd). This is lower than the traditional default for sewer design of 100 gpcd.

Furthermore, MCES has prepared future average flow projections for their system based upon 60 gpcd and 15 gallons per day (gpd) per employee. These figures are for new development and anticipate the gradual reduction of wastewater flow from existing development as a result of water conservation practices and the reduction of inflow and infiltration. It is important to note that these flow rates will vary as systems expand and age, so it is prudent to use traditional design values when looking at the design of new lateral sewer or trunk systems.

Land Use

The 2040 Land Use Plan served as the basis for the development of the sanitary sewer flow projections and analysis of the trunk system. Undeveloped land area within the City was determined to be approximately 500 acres. These areas were further defined by type of land use. Land use flow factors were used to allocate projected flows within the sewer model and are presented in Table 9.7.

Table 9.7 Land Use Flow Factors

Land Use Type	Person/ Unit	Gal/ Cap/ Day	Units/ Acre	Gal/Acre/ Day
Low Density Residential	3.5	100	1.8	630
Medium Density Residential	2.5	80	9	1,800
High Density Residential	2.0	70	14	1,960
Commercial/ Industrial				2,000
Mixed Business Campus				1,500
Institutional				1,000
Parks/Recreation				250
Undevelopable (Water/Pond)				0

Peak Flow Factors

The sanitary sewer system must be capable of handling the anticipated peak wastewater flow rate including any infiltration and inflow (I/I). The design peak flow rate can be expressed as a variable ratio to the average flow rate. Curves used to describe this ratio, called the Peak Flow Factor (PFF), indicate a decreasing ratio of peak flow to average flow with increasing average flow.

Peak Flow Factor (PFF) curves have been developed to depict this ratio and MCES has analyzed the extensive flow data within their system to correlate actual peaking factors with the formulated curves. A summary of the design peak flow factors (Figure 9.2 below) based upon current MCES data will be utilized for estimating future peak flows from development areas.

Figure 9.2 Design Peaking Factor Table

Average Flow (MGD)	Peak Hourly Flow Factor	Average Flow (MGD)	Peak Hourly Flow Factor
0.00 – 0.11	4.0	1.90 – 2.29	2.8
0.12 – 0.18	3.9	2.30 – 2.89	2.7
0.19 – 0.23	3.8	2.90 – 3.49	2.6
0.24 – 0.29	3.7	3.50 – 4.19	2.5
0.30 – 0.39	3.6	4.20 – 5.09	2.4
0.40 – 0.49	3.5	5.10 – 6.39	2.3
0.50 – 0.64	3.4	6.40 – 7.99	2.2
0.65 – 0.79	3.3	8.00 – 10.39	2.1
0.80 – 0.99	3.2	10.40 – 13.49	2.0
1.00 – 1.19	3.1	13.50 – 17.99	1.9
1.20 – 1.49	3.0	18.00 – 29.99	1.8
1.50 – 1.89	2.9	over 30.00	1.7

MCES has recognized that these peaking factors reflect that sanitary sewers (local and regional) have been designed for an average combined flow for residential, commercial, and industrial contributions of 100 gallons per capita per day. Since the current actual average is approximately 85 gallons per capita per day MCES has adjusted the peak flow factors upward (divided by 0.85) for determining I/I mitigation. This adjustment essentially reflects the available capacity for any additional infiltration and inflow in the system. These are then used to set the peak flow metershed goals for each community. Figure 9.3 below summarizes the peaking factors for MCES metershed goals.

Figure 9.3 MCES Metershed Goal Peaking Factors

Average Flow (MGD)	Peak Hourly Flow Factor	Average Flow (MGD)	Peak Hourly Flow Factor
<0.10	4.5	2.51 - 3.00	3.2
0.11- 0.20	4.4	3.01 - 3.50	3.1
0.21-0.30	4.3	3.51 - 4.00	3.0
0.31-0.40	4.2	4.01 - 4.50	2.9
0.41-0.50	4.1	4.51 - 5.00	2.8
0.51-0.60	4.0	5.01 - 6.00	2.7
0.61-0.70	3.9	6.01 - 8.00	2.6
0.71-0.80	3.8	8.01 – 10.00	2.5
0.81-1.00	3.7	10.01 - 12.00	2.4
1.01-1.20	3.6	12.01 - 16.00	2.3
1.21-1.50	3.5	16.01 - 20.00	2.2
1.51-2.00	3.4	20.01 - 30.00	2.1
2.01-2.50	3.3	>30.00	2.0

Wastewater Flow Projections

When forecasting flows for communities that are mostly developed, historical data is used to determine total flow projections for the community. The 10-year annual average per capita flow rate from Apple Valley is approximately 66 gallons per day (gpd), which is slightly lower than the current overall MCES system average of 85 gpd. This may be an indication of the general trend in water conservation similar to what the City has seen with the water system. It could also be an indication that the overall average I/I in Apple Valley's system is slightly below the metro area system average. While it is expected that water conservation within existing households will continue to improve. The existing sanitary sewer system will continue to age thus for planning purposes the City will use an overall per capita average of 100 gpd for future flow projections. This is a slightly more conservative value than historical data, but it is close to the current metershed goals set by MCES for the City as summarized below in Table 9.8. It is prudent to plan conservatively for long-lived infrastructure needs such as sewer systems.

Table 9.8 Current MCES Metershed Goals

Monitoring Period: Jan 1 – Dec 31, 2018			
Metershed	Adjusted Total Daily Flow (MGD)	Peak Hourly Flow Factor	I/I Goal (MGD)
M643	1.47	3.50	5.13
M644A	0.15	4.40	0.65
M644	1.06	3.60	3.80
M648	0.87	3.70	3.22
Total	3.55		12.80

*Equates to approximately 67 gpcd based upon estimated 2018 population of 52,795.

Annual average wastewater flow projections through 2040 are summarized below in Table 9.9. These estimates are based upon an overall system average of 85 gallons per capita per day (gpcd), and assumes that there will be no unsewered properties remaining in the future. The projections for Metersheds M643, M644A, and M644 remain relatively the same as existing since that area is already fully developed and not anticipated to have any changes due to redevelopment. The undeveloped area in the southeastern area of the City is served by Metershed M648.

Table 9.9 Average Annual Wastewater Flow Projections

Year	Projected Total Average Annual Flow (MGD)			
	M643	M644A	M644	M648
2020	1.47	0.31	1.13	0.88
2025*	1.47	0.31	1.15	0.94
2030	1.47	0.31	1.16	1.01
2035*	1.48	0.32	1.17	1.07
2040	1.48	0.32	1.17	1.15

These projections agree with MCES projections to the Empire and Seneca WWTP. (Table 9.10) Metershed M644A flows to Seneca WWTP and the other metersheds flow to Empire WWTP.

Table 9.10 MCES Projected Flows by Treatment Facility

Year	Projected Avg Flow to Empire WWTP (MGD)	Projected Avg Flow to Seneca WWTP (MGD)	Projected Total Flow (MGD)
2020	3.48	0.31	3.79
2025*	3.56	0.31	3.87
2030	3.64	0.31	3.95
2035*	3.72	0.32	4.04
2040	3.80	0.32	4.12

Ref: Metropolitan Council Thrive 2040 Water Resources Policy Plan May 2015

* Interpolated Values

Sanitary Sewer Trunk System Analysis

General

In order to gain an understanding of the hydraulic capacity of the existing wastewater collection system, a hydraulic model of the key system back bone components of the system was developed. To setup the hydraulic model, information was collected from an extensive database of GIS (Geographic Information System), field data collection and staff knowledge about the lift stations, trunk sewer mains and forcemains. Wastewater flow information was collected from flow monitoring data along with individual water meter data from the customer database to allocate wastewater flows throughout the community. Future sewer flows were determined from information provided by the Land Use Plan in which demands were determined by land use categories for undeveloped areas.

System Design Recommendations

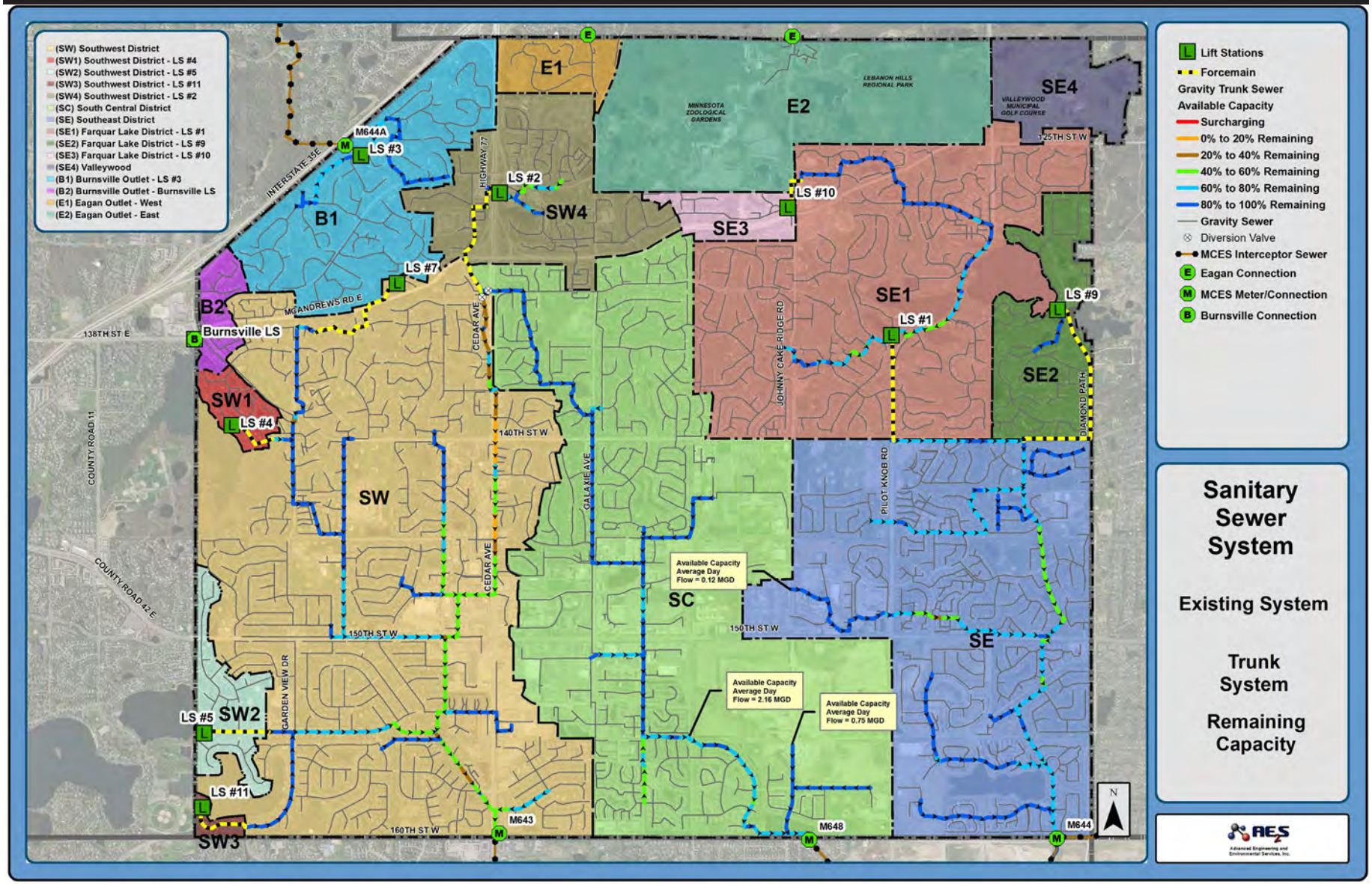
The hydraulic model analysis was performed to determine the available capacity within the existing system. After determination of available capacity, a layout of remaining future gravity sewers was incorporated into the hydraulic model. The potential system was sized based on established sewer design criteria including minimum slopes and minimum velocity. GIS information was utilized to determine ground elevations and preliminary slopes for the extension of sewers considering depth requirements and connections to existing sewers. Trunk sewer was laid out in the undeveloped gravel mining area and flows were allocated based on proposed land use.

Capacity analysis was completed for the trunk sewer system to determine the remaining available capacity within the existing system. A map showing available capacity is shown in Figure 9.4.

Analysis using the hydraulic model showed that no areas within the existing system experience surcharging. Surcharging is defined as overloading of the sewer beyond its design capacity. Although no areas surcharge, a few areas of the trunk sewer are within the 10% to 40% range of remaining capacity and should be reviewed with the model if and when re-development would occur in the future.

Available capacity was labeled at key locations with large undeveloped areas. Future analysis including the addition of 500 acres of undeveloped land showed adequate capacity to handle the planned land use for these areas. It is recommended to use the updated hydraulic model to review future development of these areas as actual development information becomes available.

Figure 9.4 Sanitary Sewer Trunk System Remaining Capacity



Infiltration and Inflow

General

The Metropolitan Council appointed a task force that met in 2003/2004 to address the impacts of excess inflow and infiltration (I/I) on the regional system. I/I describes clear water that enters wastewater collection systems and consumes capacity of the conveyance and treatment systems. Inflow is typically stormwater that increases peak flow in the wastewater system during and after rainfall events from point sources such as broken manhole covers, sewer cleanouts, sump pumps, foundation drains, and rain leaders. Infiltration is typically groundwater that gradually enters the wastewater system through cracks and openings in sewer mains, service laterals, joints, and deteriorated manholes. It was determined that the cost for source removal of I/I was much more cost effective than the cost to store, convey and treat excess I/I. Therefore, the current program focuses on source removal within the communities and regional system.

In 2009/2010 the Metropolitan Council Demand Charge Task Force reviewed goals of the current program including a possible demand charge. The recommendation was to implement an on-going program similar to the existing I/I program. However, instead of a mandatory demand charge, discretion was left with MCES to institute a demand charge if a community is not working towards meeting its I/I Goal.

Included within the MCES 2040 Water Resources Policy, adopted in May of 2015 and more recently amended, is the establishment of I/I goals for all communities discharging wastewater to the regional system. Communities with excessive I/I will still be required to eliminate it within a reasonable time period. The Council has established I/I goals for each metershed. The City of Apple Valley was not on MCES's excessive I/I list and receives annual I/I goals for each metershed.

The I/I Goal is the maximum allowable discharge to the regional wastewater system expressed as a peak hourly flow rate measured in million gallons per day (mgd). The I/I Goal is equal to the adjusted average dry weather flow (ADF) multiplied by the respective peak hourly factor. The ADF is based upon a 10 year rolling average of meter flow data and is adjusted upward by population growth for future forecasting. As part of the ongoing I/I efforts a procedure manual is updated by the Metropolitan Council for the subsequent program year. The City's Comprehensive Sanitary Sewer Plan (See Appendix) addresses the MCES specific requirements.

Existing I/I

Average dry weather flows can be compared to annual average and peak month flows to determine the amount of I/I entering the system. To understand if groundwater plays a role during dry weather periods, the average dry weather flows can be compared to the water use for that same period. These flows should closely correlate since no wet weather rainfall events or lawn sprinkling occurs in the winter/early spring time. For Apple Valley, the dry weather flow averages about 97% of the water use for the same period indicating that there is no base infiltration in the winter/early spring time. Table 9.11 summarizes average annual, average dry weather and peak month flows for the last 10-years. It also compares the various flows to help quantify the amount of I/I entering the system on an average basis.

Table 9.11 Average Annual Wastewater Flow							
Year	Population	Average Annual Flow : AA (MGD)	Average Dry Weather Flow : AD (MGD)	Peak Month Flow : PM (MGD)	Base I/I AA - AD (MGD)	Average Wet Weather I/I PM - AA (MGD)	Peak Month to Annual Average Ratio
2007	50,595	3.54	3.52	4.47	0.02	0.93	1.26
2008	51,120	3.40	3.40	4.19	0.00	0.79	1.23
2009	50,149	3.39	3.35	4.10	0.04	0.71	1.21
2010	49,084	3.36	3.33	4.84	0.03	1.48	1.44
2011	50,330	3.38	3.38	4.29	0.00	0.91	1.27
2012	50,340	3.29	3.23	4.69	0.06	1.40	1.43
2013	50,400	3.32	3.29	4.42	0.03	1.10	1.33
2014	50,600	3.28	3.24	4.94	0.04	1.66	1.51
2015	50,161	3.20	3.20	4.15	0.00	0.95	1.30
2016	50,450	3.20	3.19	3.76	0.01	0.56	1.18
Average I/I Flow (MGD)						**1.05**	
Average I/I Per Capita (GPCD)						**20.8**	
Average I/I %						**31**	

Comparing annual average (AA) to average dry weather (AD) the average flow attributable to I/I is approximately 0.02 mgd or 0.5 gallons per capita per day, which could be considered the base I/I. The average peak month (PM) to annual average ratio is 1.31, which not overly excessive when looking at typical peaking factors. This equates to an average I/I contribution of approximately 1.05 mgd during wet weather periods.

By looking at flows over the course of a year it is possible to quantify I/I on an average basis. However, it is much more difficult to determine peak instantaneous or peak hour events that are mostly associated with inflow. A one (1) inch rainfall event could have a large impact on the system or minimal impact depending upon the duration and intensity as well as other factors for each particular event. Typically no two events are the same, and at best patterns can be determined for general rainfall amounts. To pinpoint peak hour events it requires a significant amount of flow monitoring at several locations in a large system. There has been only limited data collected during previous mitigation efforts which makes it is difficult to accurately quantify for the entire system.

On-going Mitigation Plan

The City has a proactive program directed at identifying and correcting I/I, including the following:

- Stringent testing of all new sanitary sewer lines
- Televising of clay pipes as well as areas where problems have been identified
- Reconstruction projects, including replacing clay pipe with PVC, replacing manhole structures, installing gator wrap around chimney section
- Lining manholes, approximately 1 to 3 annually
- Cured In Place Pipe (CIPP) Lining spot repairs
- Lining entire sections of sanitary sewer lines with reconstruct projects and areas as identified
- Manhole inspection as part of sewer cleaning operations, which are performed daily March through November, weather permitting. Approximately one third of the system is cleaned (and manholes inspected) annually. Manholes are also inspected as part of the televising program. Manholes are repaired as needed. Internal chimney seals are installed on manholes with plastic rings where I/I has been identified.
- Additional manhole inspections (Example Lift Station 4 Project - proposed project lining of structures because of length of time before reconstruct of area)

- Manhole repair, including chemical injection and coatings
- Sewer flow meters in 2018 and 2019 budget – plan is to compare sewer flow data with Advanced Meter Infrastructure (AMI) meter data in select areas
- Sump pump inspection program – to be conducted with the meter replacement project
- Employee education – NPDES annual training
- Resident education – website, newsletters
- Field observation – wet weather manhole inspections & additional observations, such as when conducting a GSOC locate adjacent private parking lot street, crew found a sanitary manhole with a storm grate cover on it. Crew replaced the manhole grate cover with a solid cover and the business was notified.
- City Code that promotes reduced I/I – The current code prohibits owners, occupants or users of any premises to direct into or allow any storm water, surface water, water from air conditioner systems, oil or other material to drain into the sanitary sewer system

Individual Sewage Treatment Systems

The City of Apple Valley currently has an ordinance regulating the installation of on-site wastewater disposal systems. Under this ordinance, the design of the system is reviewed and permitted in accordance with the guidelines of Minnesota Pollution Control Agency Standards MN Rule 7080, 7081, 7082 and its amendments. A copy of the City's ordinance is provided in the Comprehensive Sewer Plan.

The locations of present on-site systems are shown on Figure 9.5. At the present time, no significant problems are known to exist for the existing on-site systems.

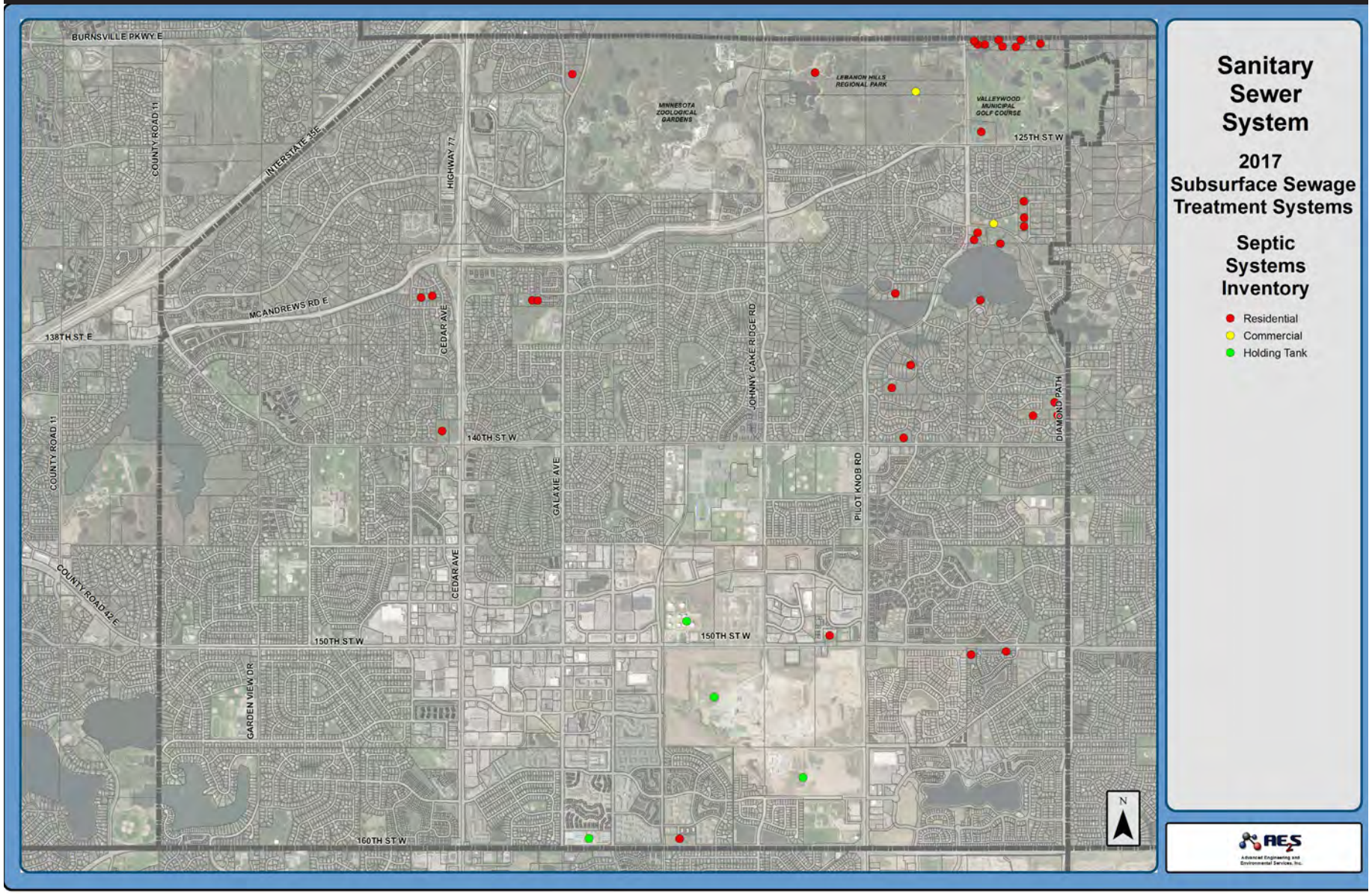
Capital Improvement Program

The City of Apple Valley is committed to providing a sanitary sewer system that meets the City's current and future needs and agrees with MCES goals and projections. Most of the City's trunk system has been constructed. The trunk system will be expanded in the few remaining areas as development proceeds. Based on the computer modeling analysis, the addition of 500 acres of undeveloped land shows adequate capacity in the current system to handle the planned land use for these areas. The hydraulic model will be updated on an on-going bass to review future development of these areas as actual development information becomes available.

Future Capital Improvement Plan (CIP) projects will explore and identify ways to improve the sanitary sewer system, such as during reconstruction projects for sanitary sewer mains, lift stations and forcemains. In addition, the City will continue its current operation, maintenance and I/I reduction efforts as identified previously.

Preventative maintenance is extremely important in the life of a sanitary sewer system. Preventative maintenance includes but not limited to monthly and annual inspections, SCADA monitoring, electrical inspections.

Figure 9.5 Subsurface Sewage Treatment Systems



Water Utility

The City of Apple Valley is committed to delivering safe, clean drinking water to the community in a water system that will meet the needed demand and supply water for fire suppression. The City routinely updates its water supply plan, water rates and capital improvement plan to ensure that the plans are current, relevant and effective to meet the City's needs into the future. The plans serve as guides for construction, operation and maintenance of the municipal water system.

Apple Valley completed a Water Supply and Distribution Plan in October 2002 and a DNR Water Emergency and Conservation Plan in October 2006 (Amended in March 2008), which were reviewed in conjunction with the 2030 Comprehensive Plan.

Metropolitan Council requires that the City submit a Water Supply Plan as part of the 2040 comprehensive plan update. In addition, all public water suppliers in Minnesota that operate a public water distribution system, serve more than 1,000 people and/or all cities in the seven-county metropolitan area, must have a water supply plan approved by the Department of Natural Resources (DNR). To obtain more detail about Apple Valley's existing and future water supply, see the 2018 Minnesota DNR Water Supply Plan, which is included as an Appendix to this Comprehensive Plan.

Water Use

Historical Water Use

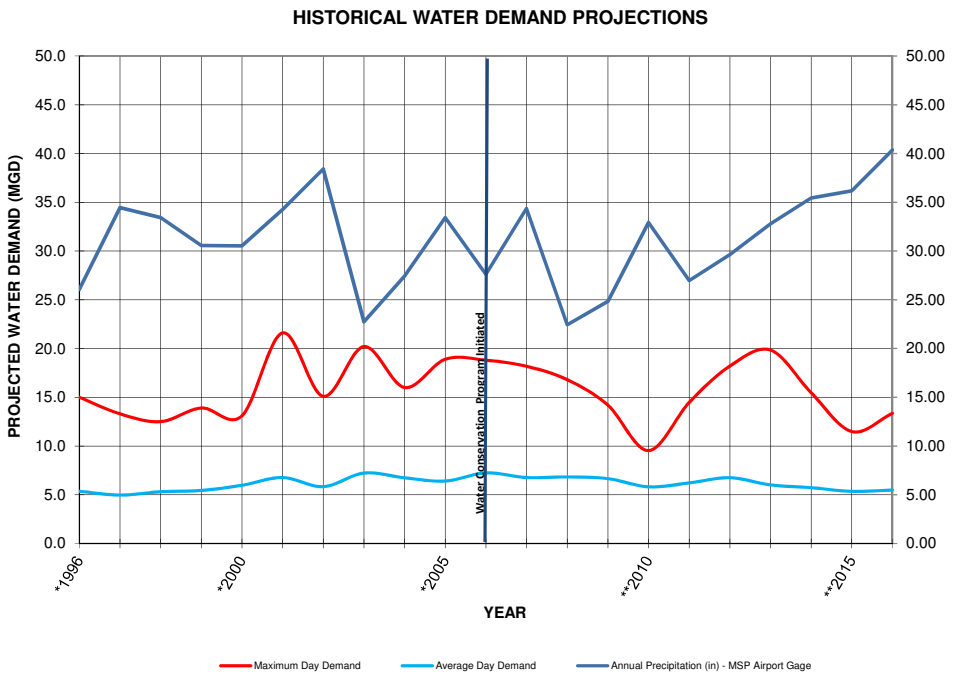
Growth has not occurred as rapidly as projected in previous plans such as the Water Emergency and Conservation Plan (2006) or the City's Comprehensive Plan (2009). Previous plans projected the 2016 population served to be 66,641 people while the actual reported 2016 population served was approximately 50,350 people. However, future growth and increased population and resulting water demand is anticipated, as addressed in a following section.

Water use in Apple Valley from 1996 to 2016 is described in Figure 9.W1. More detailed information is provided in the current and previous DNR Water Supply Plans.

Some key water demand factors to note include:

Average Daily Demand: The average daily demand (total annual demand divided by 365) has begun to exhibit a downward trend over the last decade. The past 5-year average is 5.9 MGD, which is a decrease from the 5-year average of 6.6 MGD reported in the 2006 DNR Water Supply Plan.

Figure 9.W1 Historical Water Demand 1996 through 2016



Maximum Daily Demand: Maximum daily demand over the past decade does not appear to be exhibiting an upward or downward trend. Maximum day demand generally occurs during a summer month when precipitation is at its lowest amount and irrigation is at its highest amount. Annual precipitation data from the Minneapolis-St. Paul Airport can be an indicator, but does not always correlate to maximum day demand.

Peaking Factor: The water demand peaking factor is the ratio of the average maximum day to the average day. The DNR has set a goal of reducing the average 10-year peaking factor to less than 2.6. Apple Valley achieved this goal with a 10-year average peaking factor of 2.5 for 2007-2016. This was an improvement over the previous peaking factor from 1996 – 2006, which was 2.8.

Residential Per Capita Water: The DNR has set a goal of reducing the residential per capita water demand to less than 75 gallons per capita per day (gpcd). The City's recent 5-year average equaled this goal of 75 gpcd, which was an improvement over the previous 5-year average of 91 gpcd reported in the 2006 plan.

Total Per Capita Water Demand: Total per capita water demand for Apple Valley has begun to exhibit a downward trend since the adoption of the City's 2006 Water Conservation Plan. Over the last decade, the average total per capita water demand is 122.6 gpcd, which is a decline from the average of 135.8 gpcd reported in the 2006 plan.

Unaccounted (Non-revenue) Loss: Unaccounted for water use is the volume of water withdrawn from all source water minus the volume of water delivered. The value represents water "lost" by miscalculated water use due to inaccurate meters, water lost through leaks or water that is used but unmetered or otherwise undocumented. The DNR has set a goal of reducing unaccounted for water to less than 10%. Apple Valley's exceeds this goal with a recent 5-year average unaccounted for water of 9.3%. This was an improvement over the previous 5-year average of 12% reported in the 2006 plan.

Large Volume Water Users: The ten largest water users are shown in Table 9.W1. These customers account for approximately 10% of the annual consumption of water.

Table 9.W1 Large Volume Users

Customer	Gallons per Year	% Total Annual Use
Minnesota Zoo	64,686,000	3.53%
Cedar Knolls Mobile Homes	33,086,000	1.81%
Eastview High School Sprinkler A	15,952,000	0.87%
Cobblestone Lake Master Association	15,868,000	0.87%
Kingston Green Apartments	15,581,000	0.85%
Eastview High School Sprinkler B	9,630,000	0.53%
Quarry Point Park Athletic Complex Sprinkler	8,096,000	0.44%
Apple Valley Estates LP	7,030,000	0.38%
Uponor	6,404,000	0.35%
Paradise Car Wash	5,692,000	0.32%

Water Demand Projections

The projected annual water demand through 2040 is summarized in Table 9.W2. The Metropolitan Council provided the projected populations for the years 2020, 2030 and 2040. The population projections for all other years were extrapolated. The difference between the total population and population served is based on estimates provided in the Metropolitan Council "Thrive MSP 2040" forecast.

Over the last decade, the total per capita water demand has exhibited an average annual reduction of 2.5%. The projected total per capita demand in 2017 is based on the average total per capita demand over the last ten years. This is equal to 122.6 gpcd. The City considered reducing the total per capita demand estimate in the projections, but decided to keep it steady at the 10 year average rate of 122.6 gpcd due to the uncertainty of the water usage requirements of future residential, commercial and industrial land use development.

The projected average day demand is equal to the total per capita per day multiplied by the projected population. This is then divided by one million to get the average day demand in MGD.

The maximum day demand is based on the average annual peaking factor over the last ten years, which is 2.5. For each year the average day demand is multiplied by the peaking factor to obtain the maximum day demand in MGD.

Table 9.W2. Projected Annual Water Demand

Year	Projected Total Population	Projected Population Served	Projected Total Per Capita Water Demand (GPCD)	Projected Average Daily Demand (MGD)	Projected Maximum Daily Demand (MGD)
2017	51,713	50,629	122.6	6.2	15.2
2018	52,975	52,079	122.6	6.4	15.7
2019	54,238	53,530	122.6	6.6	16.1
2020	55,500	54,980	122.6	6.7	16.5
2021	55,870	55,399	122.6	6.8	16.6
2022	56,240	55,818	122.6	6.8	16.8
2023	56,610	56,237	122.6	6.9	16.9
2024	56,980	56,656	122.6	6.9	17.0
2025	57,350	57,075	122.6	7.0	17.2
2030	59,200	59,170	122.6	7.3	17.8
2040	63,600	63,520	122.6	7.8	19.1

GPCD – Gallons per Capita per Day **MGD** – Million Gallons per Day

The 2030 Comprehensive Planning effort projected significantly high water demands due to greater population projections and higher per capita water use projections. The comparison between previous planning effort projections and the current ones are summarized in Table 9.W3.

Table 9.W3. 2030 and 2040 Comprehensive Plan Comparison

Year	Population Served	Average Day Demand (MGD)	Max Day Demand (MGD)
Previous 2030 Projection	71,200	9.70	24.20
Current 2030 Projection	59,170	7.30	17.80
Current 2040 Projection	63,520	7.80	19.10

Existing & Future Water System

The existing and future water system for the City of Apple Valley (Figures 9.W2, 9.W3 and 9.W4) consists of wells, a water treatment plant (WTP), storage facilities, booster station and watermain ranging from 6 inch to 24 inch diameter located in three (3) pressure zones. Each component and its adequacy for the future based on the 2040 population projections and land use map is described in more detail in the following sections.

Groundwater Wells

The City's twenty wells ranging from 487 to 1127 feet deep draw drinking water from the Jordan, Prairie Du Chien - Jordan and Mt. Simon groundwater aquifers (See Table 9.W4 and Figure 9.W4). Five of these wells in the Jordan and Mt. Simon aquifers are available only for emergency use.

Table 9.W4. Water Supply Wells

Well No.	Unique Well No.	Year Installed	Capacity (gpm)	Well Depth (Feet)	Geologic Unit	Status
1	205824	1963	600	520	Jordan	Emergency Only
2	205825	1964	900	530	Jordan	Emergency Only
3	205812	1962	1,000	584	Jordan	Emergency Only
4	205820	1971	1,200	504	Jordan	Active
5	207677	1974	1,300	487	Jordan	Active
6	127263	1976	1,200	507	Jordan	Active
7	127277	1977	1,250	494	Jordan	Active
8	127297	1979	1,300	506	Jordan	Active
9	151561	1981	1,200	515	Jordan	Active
10	151563	1982	1,200	502	Jordan	Active
11	191943	1985	1,400	493	Jordan	Active
12	449257	1989	1,400	494	Jordan	Active
13	433284	1989	1,500	516	Jordan	Active
14	509056	1990	900	1120	Mt. Simon	Emergency Only
15	519955	1993	900	1127	Mt. Simon	Emergency Only
16	205823	2000	1,300	510	Prairie du Chien - Jordan	Inactive
17	603075	2001	1,800	513	Jordan	Active
18	674495	2004	1,800	515	Jordan	Active
19	731113	2006	1,600	510	Jordan	Active
20	778046	2011	1,900	495	Jordan	Active

The total capacity of Apple Valley's active wells and emergency wells is 24,350 gpm (35 MGD). The firm capacity of the system, which assumes the largest well out of service, is 22,350 gpm (32 MGD). The firm capacity without emergency wells is 18,150 gpm (26 MGD). To meet the needs of the system, firm capacity should equal or exceed the maximum day demand in accordance with AWWA (American Water Works Association) recommendations. The current wells will meet the 2040 projected maximum demand of 19.1 MGD.

The locations for future Wells No. 21, 22, 23 and 24 were selected at the time of the last comprehensive plan in 2006 when greater increase in population and water demand were expected. As indicated above, these wells are not expected to be needed by 2040. However, they will remain in the City's plan and continue to be evaluated.

Emergency Interconnections

Five Interconnections with adjacent distribution systems have been established (See Table 9.W5) and can be used for emergency and auxiliary water supply.

Table 9.W5 Emergency Interconnections

Other Water Supply System Owner	Capacity (GPM & MGD)
BURNSVILLE – COUNTY RD 11	174 TO 347 GPM, 0.25 TO 0.5 MGD (8-INCH)
ROSEMOUNT – EVERMOOR PARKWAY	347 GPM, 0.5 MGD TO 1.5 MGD (12-INCH)
ROSEMOUNT – DIAMOND PATH	347 GPM, 0.5 MGD (8-INCH)
ROSEMOUNT – DOVE TRAIL	347 GPM, 0.5 MGD (8-INCH)
LAKEVILLE – GRANADA AVENUE	347 GPM, 0.5 MGD (8-INCH)

All five (5) emergency interconnections are subject to water availability. They are utilized only with prior authorization and coordination with the requesting city.

Under emergency conditions, Apple Valley could provide water to the communities of Burnsville, Rosemount, and Lakeville. Water supply capacity will be dependent on available WTP capacity above the current daily water demand during the emergency. When an emergency connection is implemented, it is recommended to monitor pressure upstream at the nearest hydrant to gauge the amount of flow through the connection point to maintain adequate pressure within the distribution system.

Rosemount, Lakeville, and Burnsville are all able to supply water to Apple Valley. To utilize the interconnections, each City would need to evaluate their system needs to ensure adequate water for domestic and fire use.

Water Source Alternatives

Apple Valley's access to surface water is through an emergency connection with the City of Burnsville. The City of Burnsville treats both water from the Kramer Quarry (gravel mining operation) along the Minnesota River in addition to groundwater. A plan for additional surface water treatment has not been completed and is not considered practical.

Figure 9.W2 Water Distribution System

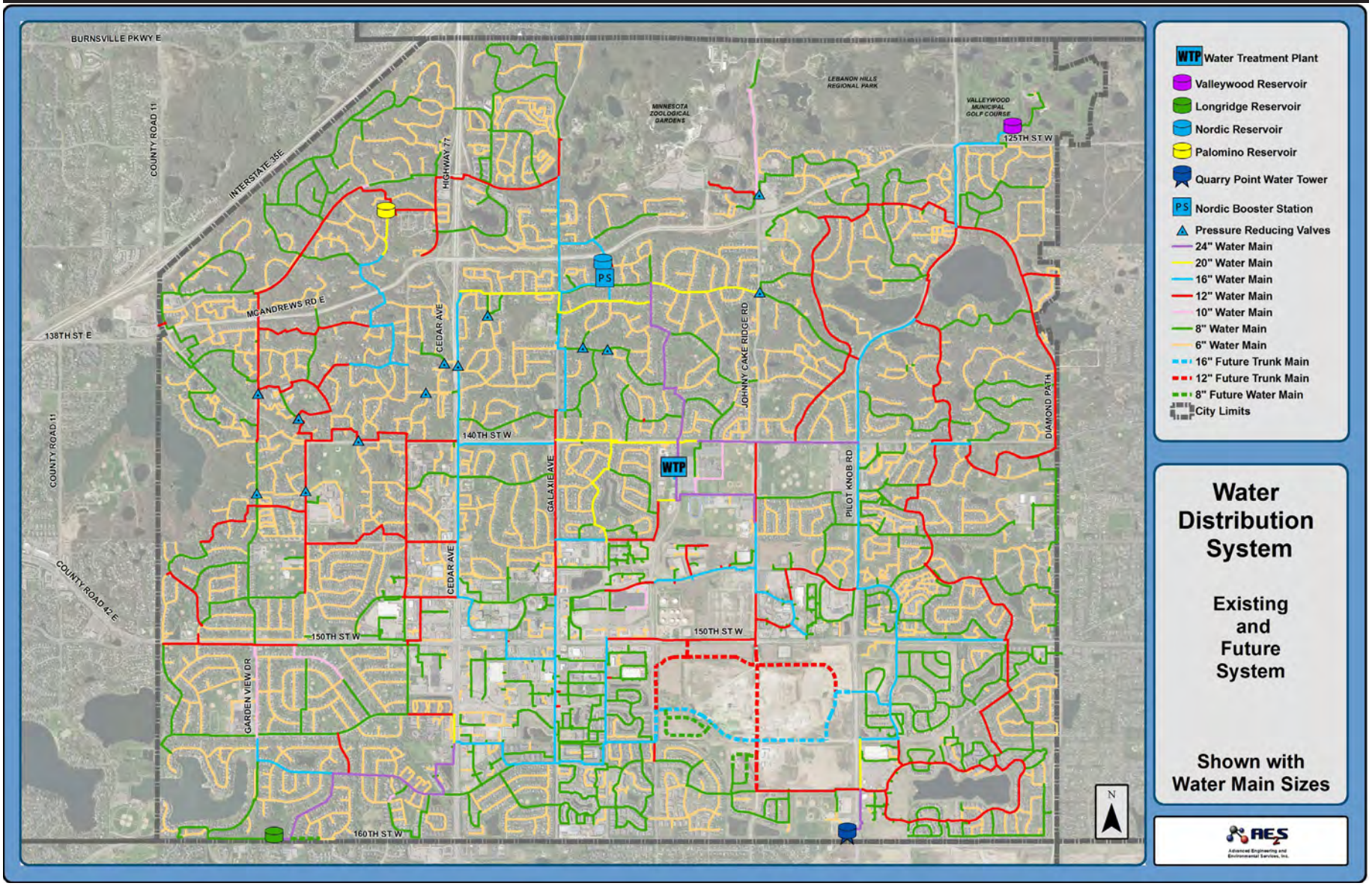


Figure 9.W3 Pressure Zones & Interconnects

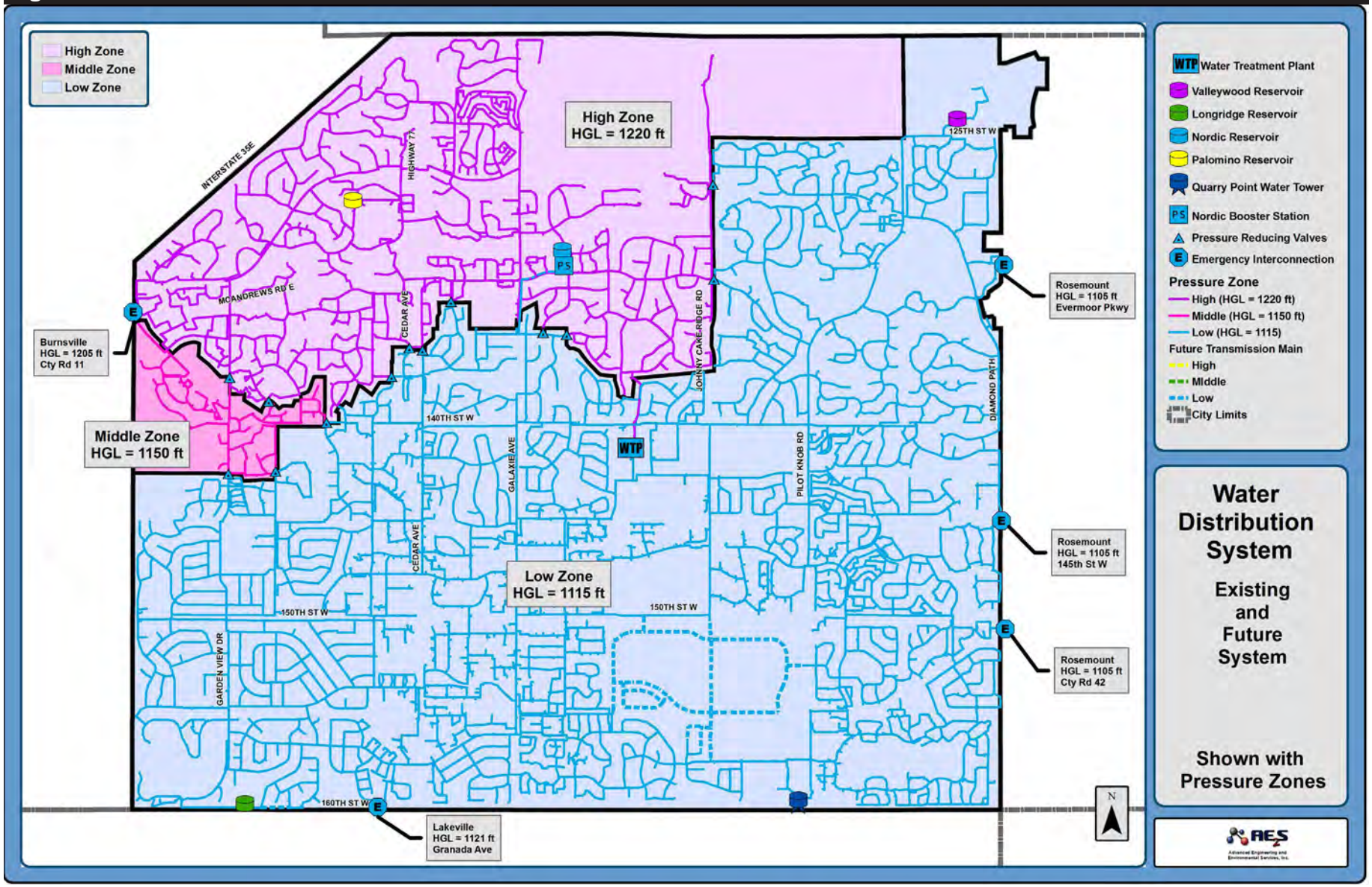
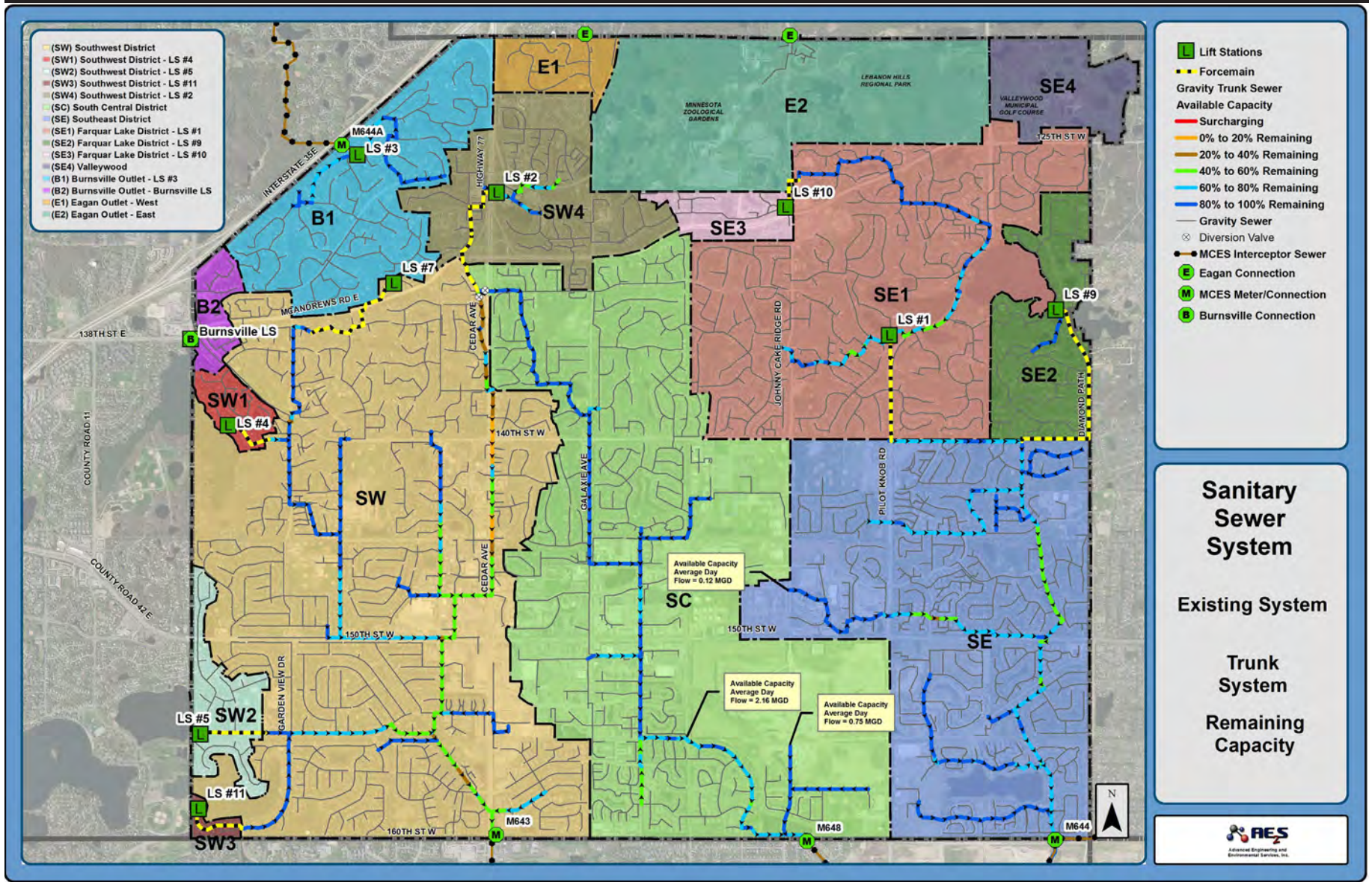


Figure 9.W4 Water Supply Wells



Water Treatment

The water treatment plant (WTP) was originally designed and constructed in 1988 to treat 12 MGD. In 1997, a filter bypass line was added so a portion of the flow could be diverted around the filter cells if usage was expected to exceed the design capacity. The bypass water was blended with the treated water prior to the chemical addition of chlorine and fluoride. By utilizing the bypass and increasing the backwashing frequency, it was possible to produce more than the designed 12 MGD. Under ideal circumstances, a maximum of 19 to 20 MGD was processed at the WTP. To ensure that the filter bypass water did not adversely impact the treated water quality, a maximum 20% bypass capacity was recommended, limiting the total plant capacity to 16.25 MGD.

In 2015, Apple Valley expanded and upgraded the WTP. The expansion added four filter cells and two backwash tanks increasing the total plant capacity to 24.4 MGD. The 24.4 MGD assumes the WTP is functional at 100% capacity with the twelve filter cells and at the recommended 20% bypass capacity.

Currently, 17 of the City's 20 wells feed into the WTP. Water from the wells is initially treated with chlorine and sodium permanganate (NaMnO4). These chemicals are used as oxidants to bring the iron and manganese out of suspension so they can be filtered out in the filter cells. The water then flows through approximately 30 inches of sand media, where the iron and manganese (no longer in suspension) are trapped on top of the media. The filtered water is then treated with chlorine and fluoride prior to flowing to the clearwell for storage until needed. From the clearwell, water flows by gravity to the pumping chamber and is pumped to the distribution system and reservoirs.

Well 16 has been offline since 2013 and is currently listed as inactive status. The water supply can be further augmented by utilizing emergency backup wells (Wells 1, 2 and 3) which pump water directly into the distribution system and are not treated by the WTP. These emergency wells have individual chlorine feed systems. Wells 14 and 15 are also considered emergency backup wells but feed into the WTP. They are both constructed in the Mt. Simon aquifer and the City is restricted from utilizing them to meet water demand.

The projected maximum water demand in 2030 and 2040 is 17.8 MGD and 19.1 MGD respectively. Current treatment capacity without the filter bypass is 18 MGD and 24.4 MGD with the filter bypass limited to 20% of the total plant capacity. Bypassing is initiated at approximately 16 to 17 MGD in anticipation of higher demands. The current water treatment plant is therefore capable of meeting the projected demands. Much of the demand can be met without bypassing the filters. However, during some of the maximum demand days a portion will need to be bypassed.

Water Storage

Apple Valley stores water in six existing storage structures as summarized in Table 9.W6. Usable storage is defined as the storage available while still maintaining a sufficient residual pressure within the distribution system. For Apple Valley, this is when the storage water level is within 40 feet of the high-water level in the reservoirs or towers. A water storage analysis was conducted to evaluate the ability of the existing storage to meet equalization, fire and emergency storage, which are defined as follows:

Equalization Storage – Capacity to meet peak hour demands while operating at a constant flow.

Fire Storage – Capacity to meet fire demands.

Emergency Storage – Capacity to meet demands during a supply or transmission pipeline outage.

Based on the future water demand projects and an average water demand of 7.8 MGD and maximum day demand of 19.1 MGD needed in 2040, the current storage facilities will continue to meet equalization storage needs, provide adequate fire flow capacity and provide emergency storage.

Table 9.W6 Water Storage

Structure Name	Type of Structure	Storage Capacity (Gallons)	Available/ Usable Storage Capacity (Gallons)
Longridge Reservoir	Ground Storage	4,000,000	3,000,000
Palomino Reservoir	Ground Storage	3,300,000	1,320,000
Nordic Reservoir	Ground Storage	2,000,000	1,290,000
Valleywood Reservoir	Ground Storage	2,000,000	1,220,000
Quarry Point Tower	Elevated Storage	1,500,000	1,500,000
Water Treatment Plant Clearwell	Other - Clearwell	2,000,000	1,500,000
Total	NA	14,800,000	9,830,000

Distribution System Hydraulic Analysis

The water distribution system consists of watermain ranging in size from 6 inch to 24 inch in diameter (Figure 9.W2) and located throughout the city. The distribution system is divided into three pressure zones (Figure 9.W3) to provide appropriate pressures to residents.

The City's hydraulic model of the distribution system was updated and calibrated in 2017. It is used as a dynamic tool for development and redevelopment planning and used to support policymakers with multi-million dollar decisions to address infrastructure needs. The hydraulic model will be continuously updated and evolve in response to the changes made within the distribution system as well as in response to changes with water system demands.

The performance of a finished water distribution system is judged by its ability to deliver the required flows (customer demands and fire-fighting needs) while maintaining adequate system pressures and water quality. Meeting these requirements, in part, depends on the components within the existing system including transmission and distribution piping, elevated water towers and ground storage reservoirs.

Analysis of pressures throughout the distribution system based on maximum day demand of 19.1 MGD are shown in Figure 9.W5. Ten States Standards recommends water pressures between 35 psi and 80 psi. A majority of the system falls within a desired level of service of 50 to 80 psi. Near pressure zone boundaries, the system could be analyzed to determine the ability to expand the upper pressure zone without exceeding 80 to 100 psi. When pressure exceeds 80 psi a pressure reducing valve is required per the State Plumbing Code.

There are a few small areas were pressures range from 30 to 40 psi near ground storage reservoirs or near the edge of a pressure zone boundary. In areas near ground storage reservoirs, individual in-house boosters would be recommended for areas with limited amount of homes effected by low pressures. In these few areas where the water pressure is lower, the water pressure/psi and flow is adequate for domestic use and fire protection.

Available fire analysis is shown in Figure 9.W6. Overall, the system can provide a minimum of 500 gpm of available fire flow throughout the system. A majority of the water system can provide at least 1,500 gpm or more of available fire flow at a residual pressure of 20 psi. An available fire flow of 1,500 gpm is typically adequate for a majority of facilities within the system. Facilities needing fire flow greater than 1,500 gpm are typically in commercial and industrial land use areas along major street corridors that typically are served by 12-inch and greater water transmission pipelines.

Figure 9.W5 Future System Static Pressures

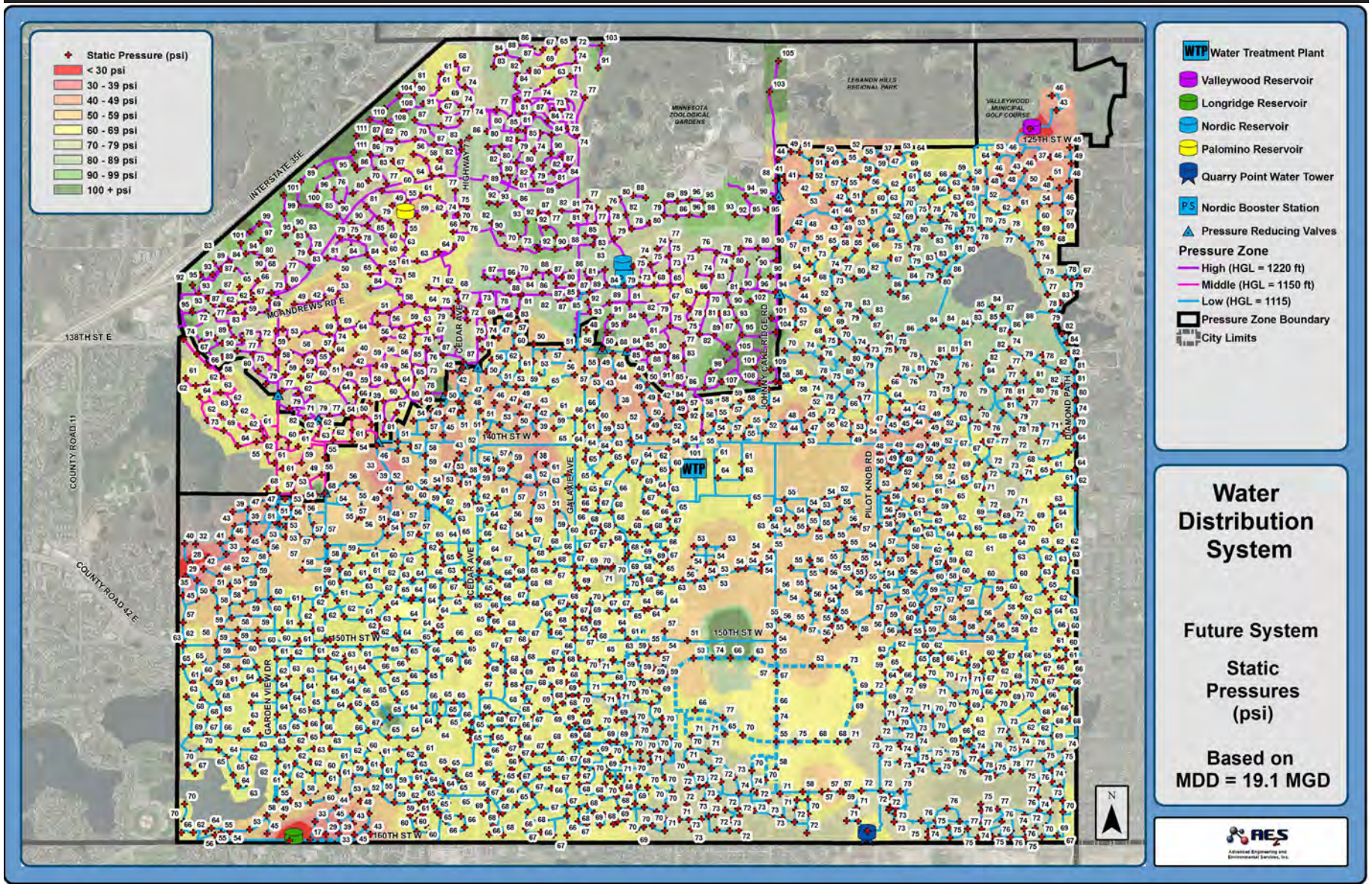
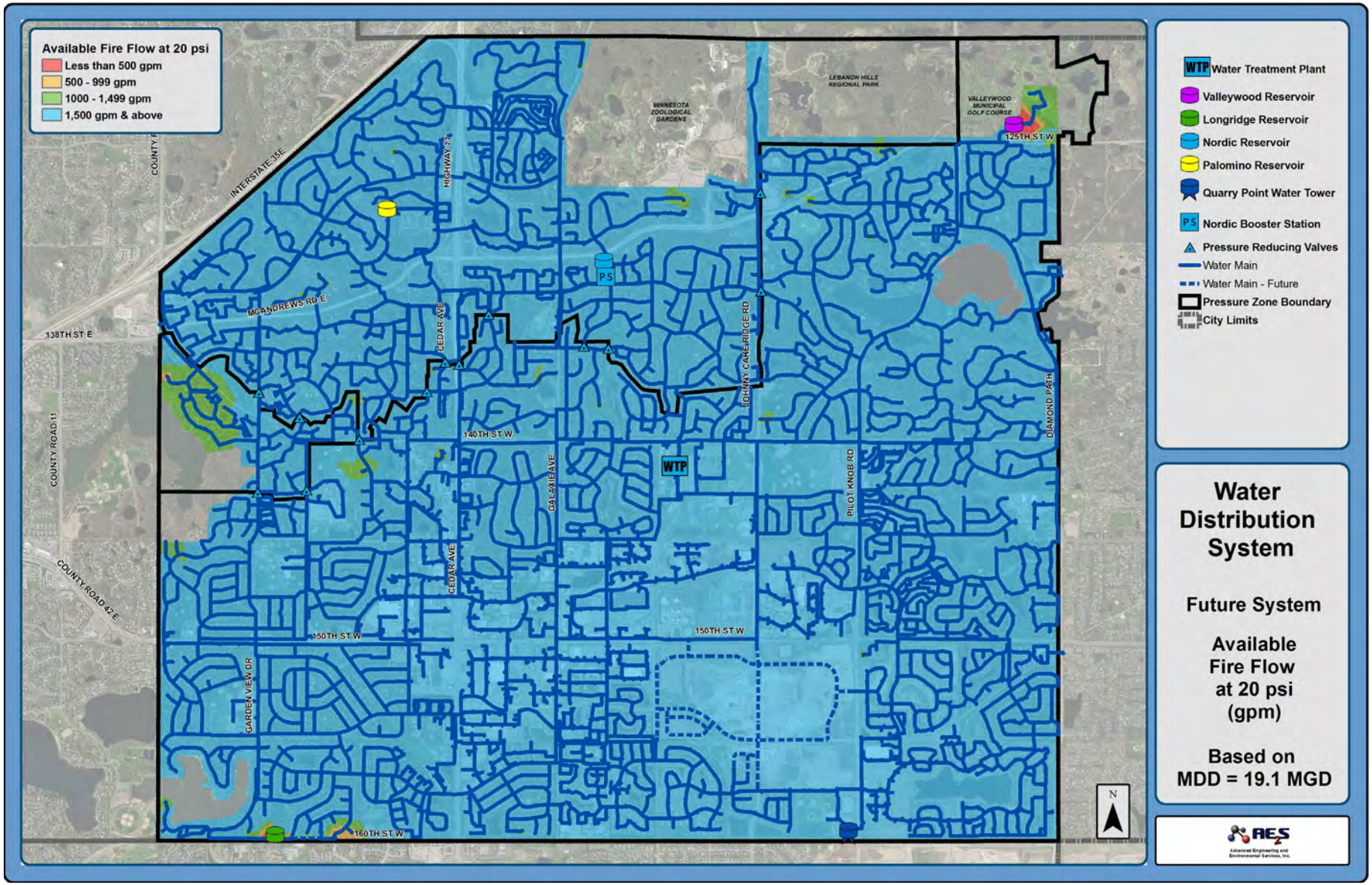


Figure 9.W6 Future System Available Fire Flow



Emergency Response Plan

Water emergencies can occur because of vandalism, sabotage, accidental contamination, mechanical problems, power failings, drought, flooding, and other natural disasters. The purpose of emergency planning is to develop emergency response procedures and to identify actions needed to improve emergency preparedness.

The City has adopted a Federal Emergency Response Plan that was certified in December 2014. In addition, the current City's DNR Water Supply Plan contains water supply protection measures, including, but not limited to, a plan for prioritizing water use, reducing demand and implementing emergency water connections.

Source Water Protection

Wellhead Protection

Wellhead protection is a means to safeguard public supply wells by preventing contaminants from entering the area that contributes water to the well or wellfield over a period of time. In 2004, the City completed a Wellhead Protection Plan (WHPP) in accordance with Minnesota rules, Chapter 4720.5200 and updated their plan in 2009. The area from which water is supplied to the City wells is identified as the Wellhead Protection Area (WHPA). The area around it, which is to be protected and managed, is defined as the Drinking Water Supply Management Area (DWSMA). These areas are delineated in the Plan and were approved by the Minnesota Department of Health on December 16, 2009.

The City's wells are considered susceptible to contamination from activities at the land surface. The plan provides management strategies that the City has developed to address the vulnerability rating of the aquifer and to protect the water supply, including, but not limited to:

- Public education programs on wellhead protection
- Proactive management of existing, unsealed and unused wells
- Proactive management of other potential sources of contamination
- Monitoring of well water levels and possible contaminants

Water Conservation Plan

Recent Conservation Efforts

The City implemented a Water Conservation Plan in 2006 through the DNR Water Emergency and Conservation Plan (Amended in March 2008). The plan addressed both conservation on the supply side (leak detection and repairs, metering), as well as on the demand side (reductions in usage).

Tracking Success

Results of conservation efforts are measured based on the water demand, water losses and peak demand trends. The residential per capita per day values, peaking factor and unaccounted for water values have each shown a downward trend since conservation efforts were implemented in 2006. The residential per capita demand has been reduced from an average of 91 gpcd in 2006 to 75 gpcd currently. The peaking factor has been reduced from an average of 2.8 in 2006 to 2.5 currently. Unaccounted water has been reduced from an average of 12% in 2006 to 9% currently.

Conservation Strategies for the Future

An updated Water Conservation Plan is included in the 2018 Minnesota Department of Natural Resources (DNR) Water Supply. (See Appendix to this Comprehensive Plan) The City plans to continue the water conservation techniques employed over the last 10 years and annually evaluate and expand them as appropriate. A meter replacement program is currently underway and it is anticipated that all meters will be replaced by 2020. The City employs conservation billing strategies for water and rates are evaluated annually.

Capital Improvement Plan & Preventative Maintenance

The City is committed to capital reinvestment of the Water Utility to achieve the goals and policies set forth and maintain the long-term sustainability of the Utility. A Capital Improvement Plan (CIP) is in place to cover expansion (if needed), repair and maintenance of the water system and is updated annually.

As discussed in this plan, the capacity of current wells, water treatment plant and storage facilities meet the future demands based on the 2040 population projections and land use map. If significant changes were to occur, such as the addition of a large water user, the water plan and resulting CIP would need to be updated.

The current water treatment plant is meeting all state and federal government regulations related to water quality. Although not anticipated, the future planning efforts and CIPs would also need to be adjusted if a currently unregulated water constituent becomes regulated, existing regulations become more stringent, or a new contaminant is identified in the wells.

Future CIP projects will explore and identify ways to improve the water system, such as investigating lower pressure areas and evaluating the benefit of increasing watermain size during reconstruction projects.

Preventative maintenance is extremely important in the life of a water supply and distribution system. Preventative maintenance is scheduled as follows:

- Production wells pulled every 7 years.
- Water treatment plant (WTP) high service pumps pulled every 8 years.
- Leak detection on one-third of the water system plus on cast iron pipe, PVC, and overlay areas, etc. - annual inspections.
- Valve operation program - scheduled as time permits.
- Hydrant flushing and inspection program - semi- annual program spring and fall
- Reservoir maintenance: warranty inspection at 2 years, touch up repairs at 10 to 12 years, total reconditioning at 20 to 25 years. Cathodic protection at selected sites - annual check.
- Valve, meter, equipment, etc. upgrades and replacements are budgeted and scheduled as necessary.