FINAL REPORT

Water System Master Plan

Prepared for

City of Millersburg

December 2017

CH2M HILL Engineers, Inc.
1100 NE Circle Blvd Suite 300
Corvallis, OR 97330

Contents

Acronyms and Abbreviations

µg/L	micrograms per liter
AC	asbestos-cement
A-M WTP	Albany-Millersburg Water Treatment Plant
ADD	average day demand
AWWA	American Water Works Association
City	City of Millersburg
cfs	cubic feet per second
CIPAC	Critical Infrastructure Partnership Advisory Council
CPC	contaminants of potential concern
DBP	Disinfection By-products
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
fps	feet per second
ft	feet
gpd	gallons per day
gpm	gallons per minutes
HAA5	haloacetic acids (5 regulated compounds)
HDPE	High density polyethylene pipe
IGA	Intergovernmental Agreement
IWA	International Water Association
ISO	Insurance Services Office
LCR	Lead and Copper Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	maximum contaminant level
MDD	maximum day demand
MG	million gallons
mgd	million gallons per day
OAR	Oregon Administrative Rules
OHA	Oregon Health Authority
OWRD	Oregon Water Resources Department
PHD	peak hour demand
ppb	part per billion
PRC	Portland State University Population Research Center

psi	pounds per square inch
Stage 2 DBP	Stage 2 Disinfection By-products Rule
TTHM	total trihalomethanes
VFD	variable frequency drive

SECTION 1

Introduction

1.1 Purpose

This report provides the City of Millersburg (City) with a water system master plan. The plan examines existing and future needs and presents recommendations and costs for improvements. The plan was developed to fulfill the state's requirements for water system master plans found in Oregon Administrative Rule (OAR) 333-061-0060 (5).

The following technical topics are covered:

- Existing system
- Historical and projected water use
- Water quality and regulations
- Service goals and policies
- Storage and distribution system evaluation
- Recommended projects to meet future demands

1.2 Intended Readers

This master plan was written for the following readers:

- Managers and staff of City of Millersburg to document the plan
- Members of the public to provide a better understanding of City of Millersburg services and responsibilities, ongoing operations and maintenance activities, facility conditions, and recommended concepts to meet current and future needs and requirements
- Subsequent engineering study and design teams for successful project implementation

It was also prepared for submission to the Oregon Health Authority Drinking Water Services program.

1.3 Organization of the Master Plan

This master plan is organized to present the logical development of recommended projects to maintain and improve water distribution system in keeping with the requirements found in OAR 333-061-0060 (5).

Section 2 describes the existing water system facilities and outlines current and future land use characteristics in the service area, which are used in the development of the hydraulic model for current and future demands. Section 3 summarizes historical water demand and future projections. Section 4 summarizes the applicable water quality regulations applied to the City. Section 5 summarizes the level of service goals for the City. The modeling results are provided in Section 6, and a list of the capital improvement projects is provided in Section 7.

SECTION 2

Description of Existing System

The City of Millersburg operates a public community water system (Public Water System Identification No. 4101533). This section describes major facilities of the City's water system.

2.1 System Overview

The City supplies water to over 700 accounts within its service area. The City's distribution system is shown on Figure 2-1.

A raw water pump station pumps water from the Santiam River to the Albany-Millersburg Water Treatment Plant (A-M WTP). The A-M WTP uses a membrane technology to filter particulate and microorganisms from the water. After filtration, water is disinfected, pH is adjusted to reduce corrosion potential in the distribution system, and fluoride is added. Filtered water is pumped to the finished water reservoir. Finished water flows by gravity from the reservoir to the Cities of Albany and Millersburg.

The City's service area encompasses nearly 2,900 acres. Approximately 800 of these acres will not be developed in the future. These areas include:

- Wetlands and creeks in the northern portion of the study area.
- Talking Waters Garden site.
- International Paper site treatment lagoons and landfill. It is unlikely that the treatment lagoons and landfill will be developed, but will be converted to wetlands and covered in place, respectively.

The remaining 2,100 acres are expected to be developed in the future based on zoning. The zoning areas are shown on the map provided in Figure 2-2.

2.2 Source of Supply

The City holds two water use permits that allow up to 22 cubic feet per second (cfs) (14.2 million gallons per day [mgd]) total flow from the South Santiam River, the Willamette River, or a combination of the two sources. Permit S-52885 authorizes up to 22.0 cfs from the Willamette River and Permit S-52886 authorizes use of up to 22.0 cfs from the South Santiam River, but the city's diversion under both permits cannot exceed a total of 22.0 cfs. The City does not have any other water sources.

Permit S-52885 authorizes appropriation of up to 22.0 cfs (in combination with Permit S-52886) from the Willamette River for municipal use. This permit has a priority date of August 31, 1989 and has an original date for completion of development of October 1, 1999. The city applied for an extension of time for completion of development, and on March 25, 2008, Oregon Water Resources Department (OWRD) issued a final order, extending the completion date to October 1, 2049.

The city's second permit, S-52886, authorizes appropriation of up to 22.0 cfs (in combination with Permit S-52885) from the South Santiam River for municipal use. The permit has a priority date of August 31, 1989, and had an original date for completion of development of October 1, 1999. The City applied for and received an extension of time, which authorized a new completion date of October 1, 2049. Permit S-52886 originally authorized appropriation from a point of diversion on the South Santiam River. The point of diversion was subsequently changed to the Santiam River through permit amendment T-8257. Use of water is limited to the amount of water lawfully available at the original point of diversion. In addition, the city applied for a permit amendment (T-9639) to change the point of diversion to more correctly identify the location on the Santiam River, and change the place of use to add the City of Albany to the service area. OWRD issued an order approving T-9639 on January 14, 2008.

If there are restrictions on surface water withdrawals in the Santiam River and City's water right is unavailable, the City is entitled to access a portion of the City of Albany's water rights as part of an Intergovernmental Agreement (IGA) signed in 2016. Albany has water rights from 1878 and 1979.

2.3 Interconnections with Other Systems

The Cities of Millersburg and Albany have an emergency intertie at 3246 Salem Avenue NE. During an emergency when the A-M WTP is not fully functional, the City of Albany can provide water from its Vine Street WTP to Millersburg through this intertie.

2.4 Intergovernmental Agreements

The City of Millersburg entered IGAs with the City of Albany for water distribution system maintenance services and for jointly-owned water facilities in 2016. These IGAs repealed previous agreements from 2005.

The water facilities jointly owned by the Cities of Albany and Millersburg include the water intake, pump station and pressure main, the A-M WTP, finished water reservoir, and the finished water pipeline up to the Millersburg water meter. Albany employs the operator designated as the direct responsible charge (DRC) to supervise the A-M WTP up to the point of delivery to the Millersburg water system. Millersburg's public water system begins downstream of a 12-inch-diameter water meter near the intersection of Century Drive NE and Berry Drive NE. The meter is called the Millersburg master meter. Millersburg employs the operator designated as the DRC to supervise Millersburg's distribution system downstream of the Millersburg master meter.

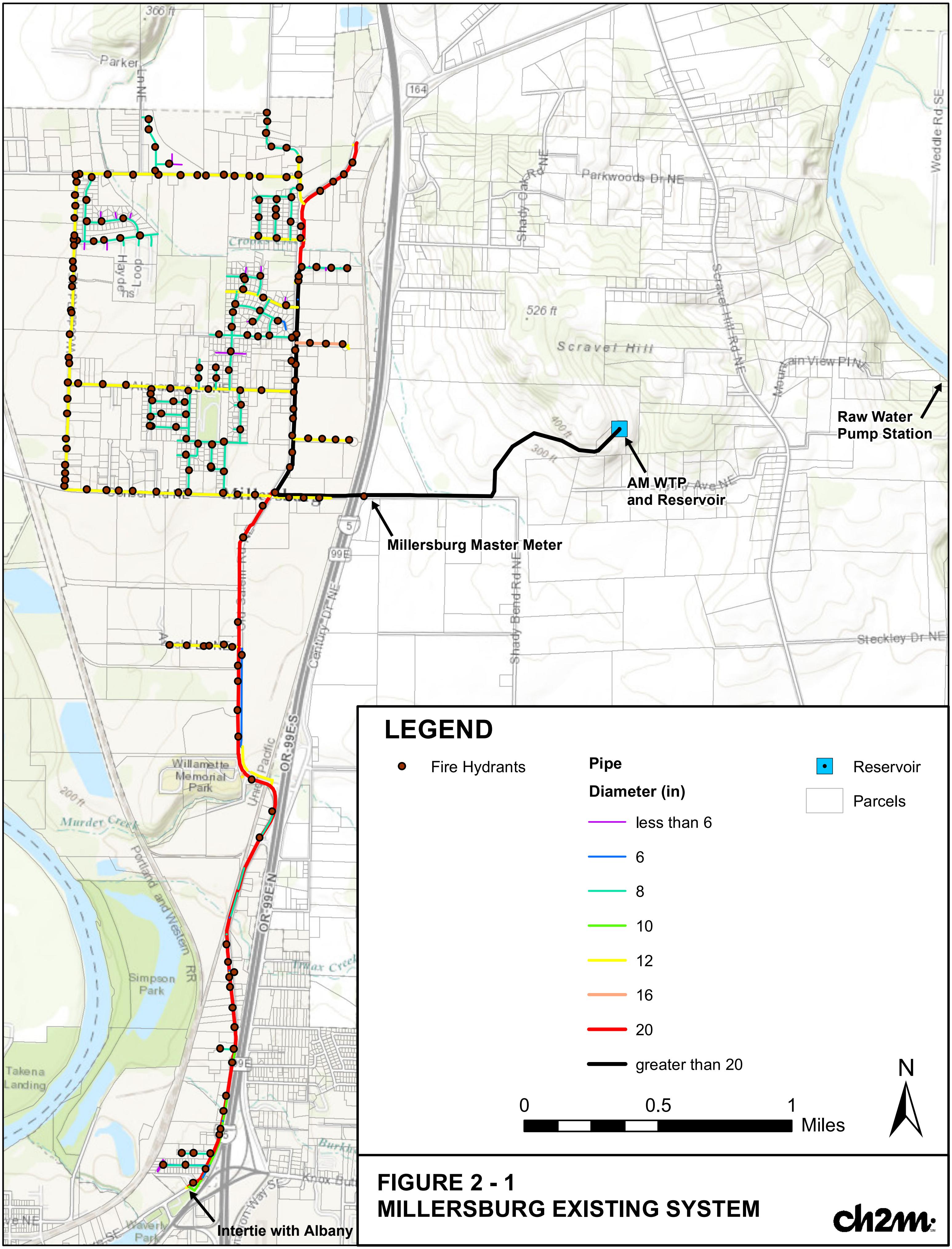
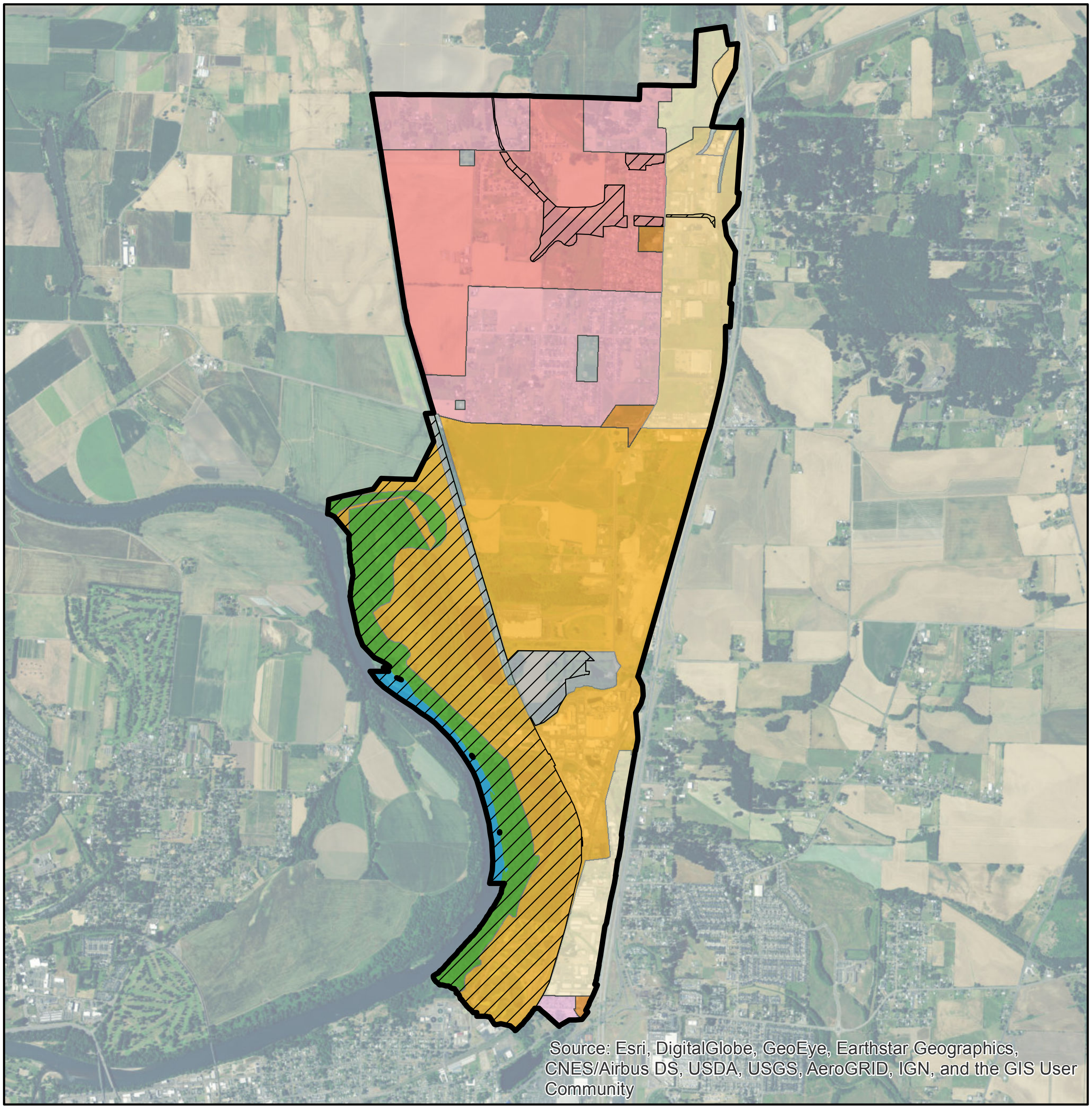
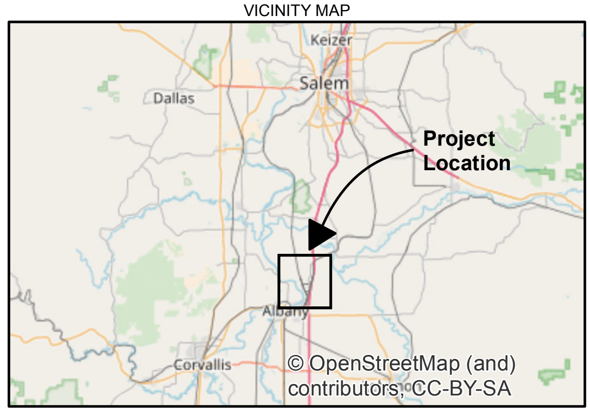


FIGURE 2 - 1
MILLERSBURG EXISTING SYSTEM



VICINITY MAP



Legend

City Limits

Area Not Developed in Future

ZONING

Green (GRN)

Commercial Center (CC)

Heavy Industrial (HI)

Limited Industrial (LI)

Limited Industrial/Commerical (LIC)

Rural Residential 10UC (RR10)

Rural Residential 2.5UC (RR2.5)

Urban Residential (UR)

Public (PUB)

Water (WATER)

N

0 2,000 4,000 8,000 Feet

FIGURE 2-2
Land Use

ch2m

2.5 Treatment

From the raw water pump station at the Santiam River, four vertical turbine pumps are used to pump water to the A-M WTP. Each 350-horsepower pump has a maximum capacity of 4,500 gallons per minute (gpm), 220 feet of dynamic head, and is equipped with a variable frequency drive (VFD). The pumps operate three duty and one standby.

At the treatment plant, a membrane technology is employed to filter particulates and microorganisms from the water. After filtration, water is disinfected, pH is adjusted to reduce corrosion in the distribution system, and fluoride is added. Finished water is pumped to the finished water reservoir by four horizontal centrifugal pumps—one pump for each membrane cell. Each of these 125-horsepower pumps is designed to convey 4,315 gpm and is equipped with a VFD.

From the finished water reservoir, water is conveyed to both cities through a 42-inch-diameter pipe. All these facilities are joint-owned by the two cities through an IGA signed in 2016.

2.6 Storage

Water is stored at the finished water reservoir near at the A-M WTP site. It fills and empties depending on system demands and the production rate of the A-M WTP. The finished water reservoir is a prestressed concrete, 5.7-million-gallon (MG) tank. Built in 2005, it stands 42 feet tall and has an overflow elevation of 415 feet. Per the IGA discussed in Section 2.4, the Cities of Millersburg and Albany equally share the tank's storage—2.85 MG each.

2.7 Distribution System

Millersburg's distribution grid consists of 4-inch-diameter through 28-inch-diameter pipes—excluding the pipelines jointly-owned by Albany and Millersburg. Nearly 90 percent of the pipes are ductile iron. There are also small amounts of asbestos cement (AC), cast iron, high-density polyethylene (HDPE), and steel pipes as well. The cast iron and steel pipes are in the area of the AC piping in the southern part of the service area along Old Salem Road. The HDPE in the distribution system was used for the I-5 crossing. Older AC, steel, and cast iron pipe may be a source of water loss in the system and replacement of these pipes should be considered over time.

There are nearly 19 miles of pipeline in the distribution system. Table 2-1 summarizes the distribution system by pipe diameter and material. Figures 2-3 and 2-4 show the distribution piping by diameter and material, respectfully.

Table 2-1. Pipe Material Inventory
City of Millersburg Water System Master Plan

Pipe Material	Length of Pipe (in feet) by Pipe Diameter									Total (feet)
	4-inch	6-inch	8-inch	10-inch	12-inch	16-inch	20-inch	24-inch	28-inch	
Asbestos Cement	55	2,005	2,804	2,854	1,040	0	3	0	0	8,761
Cast Iron	0	0	0	0	48	0	0	0	0	48
Ductile Iron	3,335	2,693	32,218	180	26,774	1,047	17,810	4,542	0	88,597
HDPE	0	0	0	0	0	0	0	0	1,739	1,739
Steel	0	0	0	31	0	0	0	0	0	31
Total (feet)	3,759	5,647	35,022	4,435	27,867	1,119	17,813	4,542	1,739	99,176

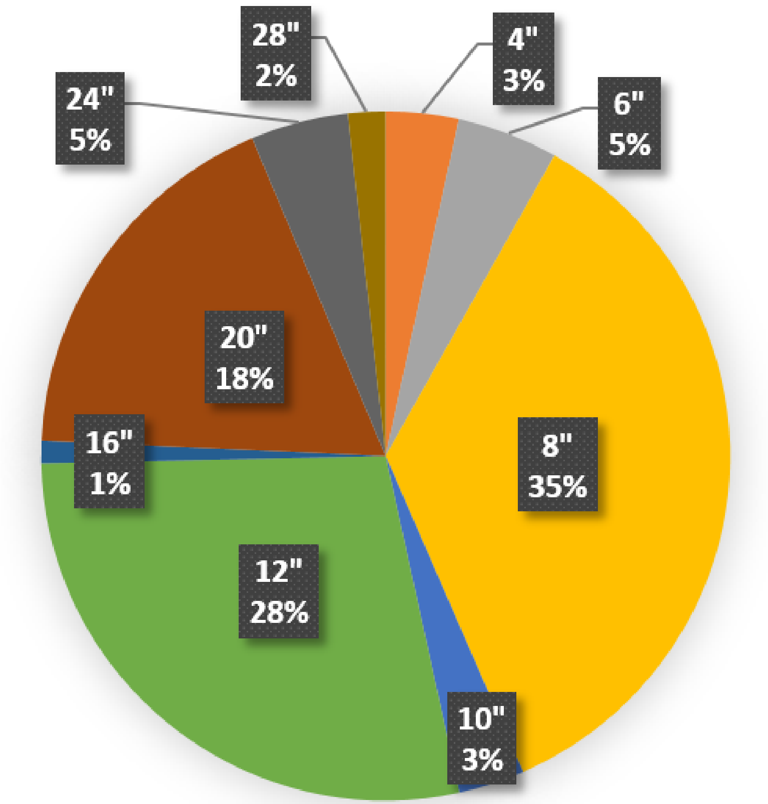


Figure 2-3. Distribution Piping Summary by Diameter

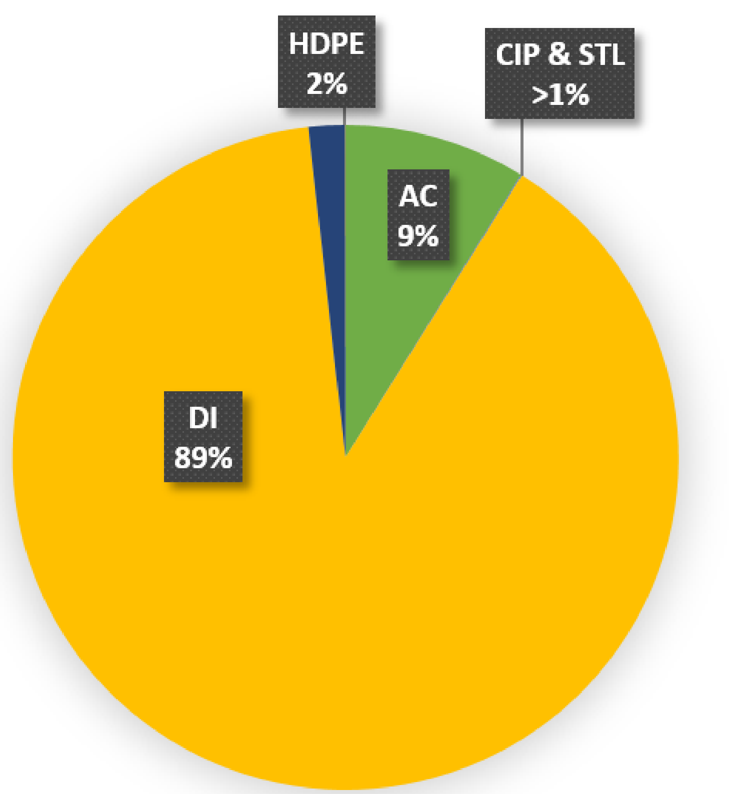


Figure 2-4. Distribution Piping Summary by Material Type

AC = asbestos cement; CIP = cast iron pipe; DI = ductile iron; HDPE = high-density polyethylene; STL = steel

The majority of the distribution system was installed after 1987. Most of the construction before 1987 was installation of the AC pipe that parallels Old Salem Road. Figure 2-5 show the length of pipe installed by 5-year increments.

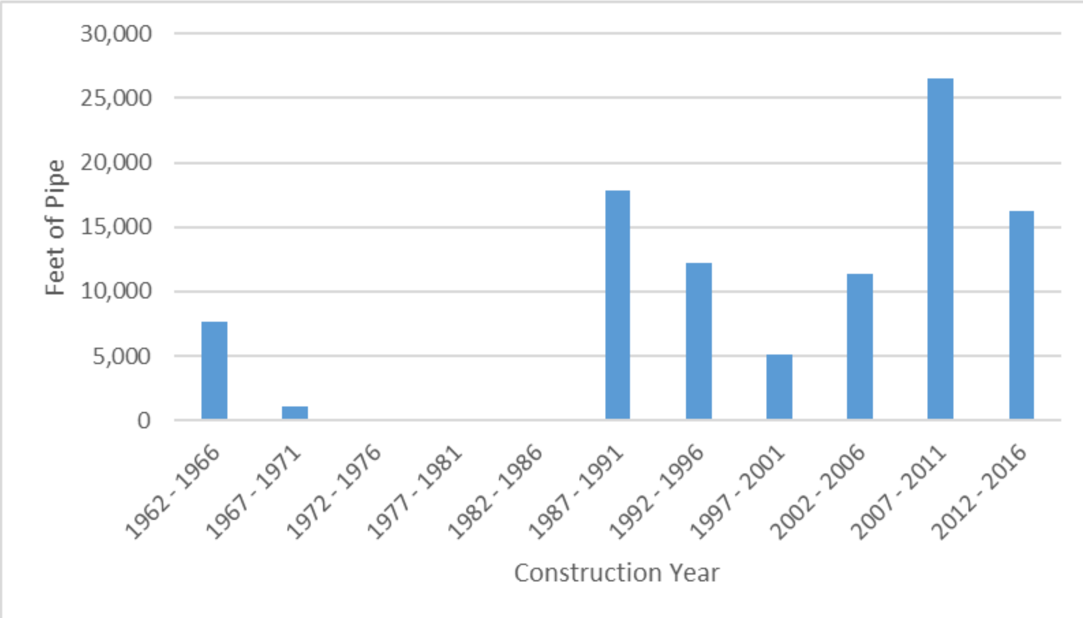


Figure 2-5. Distribution System Construction by Year

Historical and Projected Water Use

This section describes the customer base and water use records for the City, and presents projections for future water use.

3.1 Overview

The City provides drinking water to over 700 customer accounts. The majority of these are residential accounts, with the remainder being comprised of commercial and industrial accounts. Even though most accounts are residential, the biggest users are commercial and industrial accounts, which consume more than 90 percent of the City's water.

On average, the City used about 950,000 gallons per day (347 million total) in 2016, as measured by the Millersburg master meter. Over the past 5 years, the City used on average approximately 851,000 gallons per day. About 86 percent of the production reaches customers and is metered and recorded as sales to customers. The remaining 14 percent is nonrevenue water (defined in Section 3.3.1), which includes metering inaccuracies, incorrectly estimated authorized use that is not metered (such as flows from hydrants for flushing or fire-fighting), and leaks from pipes.

Demand projections have been developed by considering population trends in Millersburg and using an estimation of per capita water use.

3.2 Definition of Terms

Demand refers to total water use; that is, the sum of consumption (residential, commercial, public, and industrial) and public uses (for example, firefighting or hydrant flushing), plus water lost to leakage and other losses.

Demand is equal to the water that flows through the Millersburg master meter from the A-M WTP reservoir into Millersburg's system.

Generally, demands and consumption in municipal systems are expressed in units of gallons per day (gpd) or mgd. They may also be expressed in cfs or gpm. One mgd is equivalent to 1.55 cfs or 694 gpm. For annual or monthly values, it is typical to refer to the total quantity of water in MG. Water use per person (per capita use) is expressed in gallons per capita per day.

The following terms are used to describe specific values of system demands:

- Average day demand (ADD) equals the total annual production divided by 365 days.
- Maximum day demand (MDD) equals the highest system demand that occurs on any single day during a calendar year.
- Peak hour demand (PHD) equals the highest system demand that occurs on any single hour during a calendar year.
- Maximum monthly demand equals the highest demand in one of the 12 months of a calendar year.
- Peaking factors are the ratios of one demand value to another. The most commonly used peaking factor is the ratio of the MDD to the ADD.

MDD is an important value for water system planning. The City's portion of the river withdrawal system and treatment plant capacity must be capable of meeting the MDD. If demands exceed the capacity of these facilities, then Millersburg's portion of the finished water storage will be depleted that day. A series of high demand days would eventually put the system into a shortage. Therefore, the general rule of sizing water system supply facilities is to ensure they are larger than the MDD. Since it may take several years to expand such facilities, considering the multiple steps of planning, permitting, designing, and constructing larger facilities, it is important to initiate expansions when the projected MDD is within about 5 years of equaling the maximum capacity of the supply facilities.

3.3 Demand Records

3.3.1 Terminology

Production refers to the quantity of water delivered to the distribution system from the water treatment plant. "Production" and "demand" are synonymous as used within this report and refer to the amount of water delivered from the finished water reservoir to the City. Production (demand) may be divided into two broad categories: water that provides revenue to the utility, and water that does not provide revenue, also known as nonrevenue water. This breakdown is shown in the International Water Association/American Water Works Association (IWA/AWWA) water audit schematic provided in Table 3-1.

Revenue water consists of all billed, metered water consumption, and billed unmetered consumption (for example, water sold for construction but not metered). Nonrevenue water consists of authorized, unbilled metered or nonmetered consumption such as use for firefighting and hydrant flushing; unauthorized consumption; water loss because of meter inaccuracies; and real losses such as through leaks, reservoir overflows, and evaporation.

Table 3-1. IWA/AWWA Water Audit Methodology
City of Millersburg Water System Master Plan

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Nonmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Nonrevenue Water
			Unbilled Nonmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Metering Inaccuracies	
		Real Losses	Leakage on Transmission or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections to Customers' Meters	

The City is fully metered, so metered consumption represents the City's revenue water. Demand minus metered consumption equals nonrevenue water.

3.3.2 Annual Production (Demands)

Table 3-2 summarizes annual demand records for the City for the period of 2012 through 2016. Figure 3-1 is a graph of demand data for the entire period.

Table 3-2. Demand Records 2012 - 2016
City of Millersburg Water System Master Plan

Calendar Year	Average Day Demand (gpd)	Maximum Day Demand (gpd)	Date of Maximum Day Demand	Ratio of Maximum Day to Average Day
2012	734,000	1,240,000	10/3/2012	1.68
2013	824,000	1,790,000	6/6/2013	2.17
2014	912,000	1,550,000	9/11/2014	1.70
2015	835,000	1,370,000	9/9/2015	1.64
2016	950,000	1,460,000	8/19/2016	1.54
Average	851,000	1,480,000	-	1.74
Minimum	734,000	1,370,000	9/9/2015	1.54
Maximum	950,000	1,790,000	6/6/2013	2.17

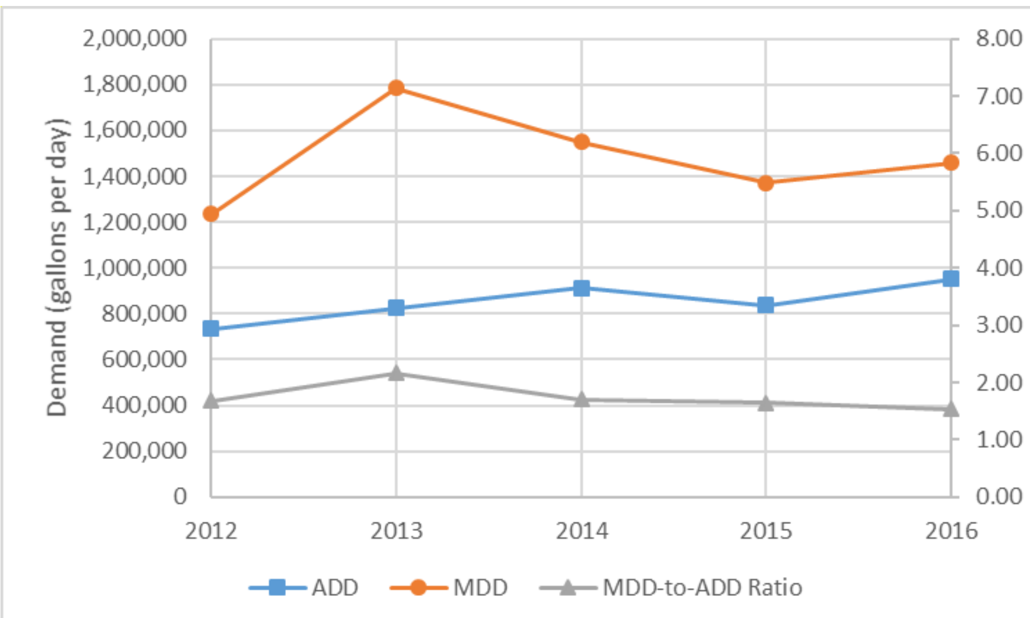


Figure 3-1. Average and Maximum Day Demand Records 2012–2016

The ADD has generally trended upward from 2012 through 2016, although the 2015 ADD was lower. The MDD has fluctuated with no clear trend. The 2015 ADD decrease was due to a decrease in water consumption by the City’s largest industrial user.

3.3.3 Monthly Production

Figure 3-2 is a bar chart presenting monthly metered production from 2012 to 2016. The City experiences increased demand for water in the months from May to October. These increases are caused by outdoor irrigation and seasonal variations for some industrial users.

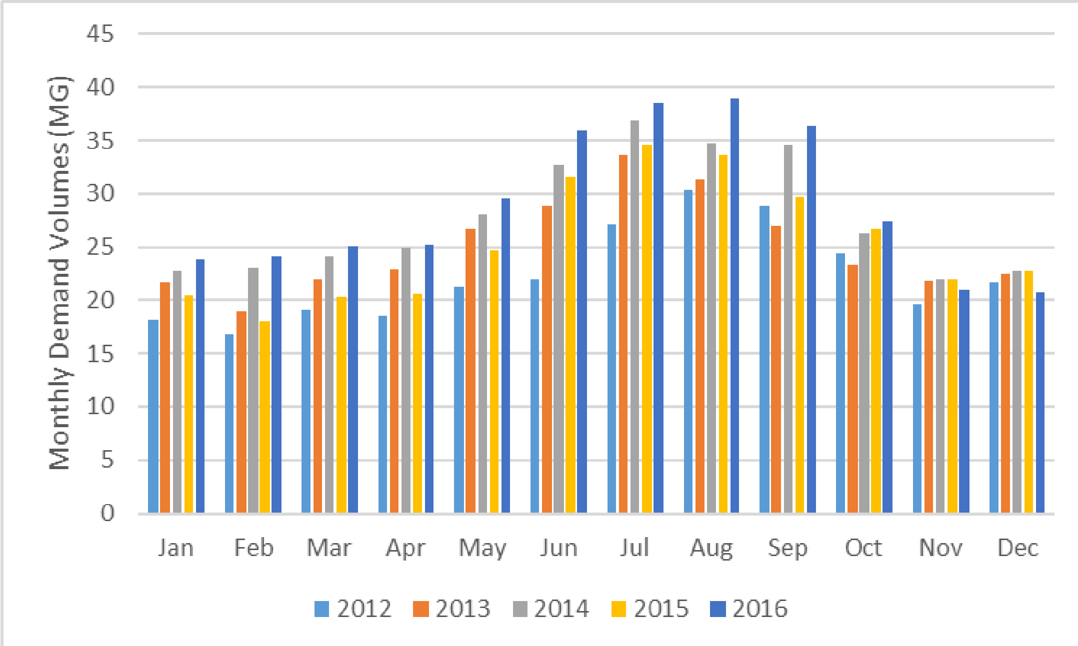


Figure 3-2. Monthly Demand 2012–2016

3.3.4 Consumption and Nonrevenue Water

Consumption values are based on metered water use within the system. All of the City's customers are metered, and *the total of the metered amounts is the system consumption.* The difference between production and metered consumption is nonrevenue water. As discussed earlier, nonrevenue water sources include authorized uses such as hydrant flushing and system losses. Losses result from meter inaccuracies (both master and customer meters), water lost to leakage, and hydrant flushing.

Table 3-3 presents production, consumption, and nonrevenue water values for 2012 through 2016. For the last 5 years, nonrevenue water averaged 44 MG per year, or 14.1 percent of total produced water. This value exceeds the target of less than 10 percent set by the OWRD. However, it is less than the 15 percent trigger OWRD has established for when a city must implement a plan to reduce leakage.[1]

Table 3-3. Production Consumption and Nonrevenue Water 2012 through 2016
City of Millersburg Water System Master Plan

Year	Production (MG)	Authorized Consumption (MG)	Unauthorized Nonrevenue Water (MG)	Unauthorized Nonrevenue Percentage of Production (MG)
2012	268	225	43	16%
2013	301	274	27	9%
2014	333	277	56	17%
2015	305	269	36	12%
2016	347	289	58	17%
Average	**311**	**267**	**44**	**14%**

[1] The OWRD's rules do not differentiate between general nonrevenue water and leakage, but instead imply that all nonrevenue water is caused by leaks. In reality, there are many sources of nonrevenue water, as described earlier in this section.

3.4 Population Projections

The population of Millersburg has grown faster than predicted in previous years. Based on Portland State University Population Research Center (PRC) census data, the City grew 104.1 percent over 10 years from 2000 to 2010. During this period, the population grew from 651 to 1,329 people with an average annual growth rate of 7.4 percent. Based on PRC 2010 to 2015 population data (Portland State University, 2016), a 5-year growth rate for the City was calculated to be 21.9 percent. The 2015 PRC projection for Millersburg is 1,620. Continuing the trend from 2010 through 2015, the 2017 population is estimated at 1,755.

Currently, there are 971 developable acres zoned for residential use. 476 of these acres have already been developed, leaving 495 acres to be developed, of which the entirety is expected to be developed. The City expects Millersburg to be built out using minimum 10,000-square-foot lots. Assuming 2.5 people per household, this results in the City adding 5,390 people over the next 20 years. Using this method, the 2037 population is estimated to be 7,145.

3.5 Demand Forecast

The City's demands were projected into the future by applying current demands per developed area to available lands. By 2037, all residential areas are expected to be developed. ADD and MDD per acre were calculated for residential areas by taking the recent ADD and MDD residential consumption records and then dividing by the area of existing, developed residential areas. These demands were then applied to all undeveloped residential areas. Because future industrial demands are very difficult to predict, no new industrial demands were projected. The information contained in this report and the model created as part of this project will enable the City to evaluate each future potential new industrial water user.

The following values were used to project future demands:

- Current residential ADD/acre = 749
- Current residential MDD/acre = 1,302
- 20-year Area Developed (acres) = 495

Table 3-4 summarizes projections for the City using these criteria. The resulting projections indicate that that by 2037, at the end of the 20-year planning horizon, the City's demands will equal 1.22 mgd for ADD and 2.12 mgd for MDD.

Table 3-4. Demand Projections
City of Millersburg Water System Master Plan

Year	ADD Projection (gpd)	MDD Projection (gpd)
2017	851,000	1,480,000
2037	1,221,000	2,124,000

Water Quality and Regulations

This section describes existing and emerging drinking water regulations, with a focus on those that are most likely to impact the City's system. The section is organized as follows:

- Water system background
- Overview of state and federal regulations
- Potential regulatory impacts
- Proposed new regulations
- Monitoring schedule for the City

4.1 Water System Background

The City of Millersburg became its own drinking water system (OR 4101533) on January 6, 2017. Before that, the City of Millersburg was considered part of the City of Albany's drinking water system (OR 4100012). During that time, any water quality testing results in the City of Millersburg were reported as part of the City of Albany's system.

4.2 Overview of State and Federal Regulations

Both state and federal agencies regulate public drinking water systems. Most federal drinking water regulations stem from the Safe Drinking Water Act, which was amended in 1996. For the federal government, the U.S. Environmental Protection Agency (EPA) establishes standards for water quality, monitoring requirements, and procedures for enforcement. Oregon, as a primacy state, has been given the primary authority for implementing EPA's rules within the state.

The state agency that administers most of EPA's drinking water rules is the Drinking Water Services section of the Oregon Health Authority (OHA). Oregon's rules for water quality standards and monitoring are adopted directly from the EPA. Oregon is required to adopt water quality rules at least as stringent as federal rules and OHA has generally elected not to implement more stringent water quality or monitoring requirements. Generally, the water quality standards are captured in the setting of maximum contaminant levels (MCLs). The one place where Oregon has implemented more stringent water quality regulations is the establishment of acute toxicity levels for algal toxins.

In some areas not directly related to water quality, Oregon's rules cover a broader scope than EPA rules. These include general construction standards, cross connection control, backflow installation standards, and other water system operation and maintenance standards. Oregon's complete drinking water regulations are contained in OAR 333-61.

The City's system is governed by the OWRD with respect to water rights. Other state agencies such as the Division of State Lands, Department of Environmental Quality (DEQ), and Fish and Wildlife Department, may have regulations that apply to the City for specific construction or periodic maintenance activities. For example, DEQ regulates discharges into open bodies of water; their regulations apply when reservoirs are drained.

The regulatory environment for drinking water utilities is currently and probably will continue to be in a state of flux as the EPA balances the need to provide increased protection against pathogens such as *Cryptosporidium* with the goal of reducing disinfection by-products. Additionally, an area of particular concern as this report was being prepared was the finding of elevated lead from drinking water taps. This issue was brought to the U.S. public's attention by the occurrences in Flint, Michigan, when the city changed to a new water source and treatment system and did not carefully anticipate the impacts on lead release from pipes and fixtures in the system. Subsequently, Oregon cities such as Portland, Corvallis, and Medford conducted monitoring beyond that required by the Lead and Copper Rule (LCR) and found elevated lead levels in schools and other public facilities.

4.2.1 Surface Water Treatment and Disinfection By-products Rules

The large 1993 outbreak of cryptosporidiosis in Milwaukee, Wisconsin, and subsequent outbreaks in other U. S. cities prompted more stringent requirements for systems treating surface water. It was recognized that higher levels of disinfection would help to control *Cryptosporidium,* but higher chlorine levels would also contribute to higher levels of disinfection by-products. The 1996 Amendments to the Safe Drinking Water Act required EPA to develop new rules to balance the risks between microbial pathogens and disinfection by-products. The resulting rules are labeled the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 Disinfection By-products Rule (Stage 2 DBP Rule).

The Stage 2 DBP Rule lowered the MCLs for total trihalomethanes (TTHMs) and haloacetic acids (HAA5) to 80 and 60 micrograms per liter (µg/L), respectively, and subsequently, revised the determination of compliance to consider each sample location independently, rather than averaging the results from all sample locations. The Stage 2 DBP Rule also changed compliance so that it is based on a running annual average for systems collecting samples on a quarterly basis. The City is required to collect two dual sample sets at two locations quarterly. In 2017, the City has not exceeded MCL limits.

Table 4-1 summarizes the recent test results.

Table 4-1. 2017 Routine Monitoring Results
City of Millersburg Water System Master Plan

Sample Location	TTHMs (µg/L)	HAA5 (µg/L)
MCL	80	60
March 2017 Testing		
3075 Kathryn St. (IDSE01)	30.5	27.9
4222 Old Salem Rd. (IDSE02)	51.4	45.9
July 2017 Testing		
3075 Kathryn St. (IDSE01)	30.5	16.7
4222 Old Salem Rd. (IDSE02)	23.5	16.5

Between 2002 and 2016, the City of Albany reported six times that DBP exceeded the MCLs. None of those samples came from within the City of Millersburg. The 3075 Kathryn Street location was used as a DBP sampling location by the City of Albany from 2006 to 2013. During that period, that location never reported DBPs above the MCLs.

4.2.2 Lead and Copper Rule

The LCR, though not new, warrants specific mention because of the heightened concerns about high lead levels in drinking water in U.S. water utilities that occurred in 2015 and 2016. Lead is almost never present in measurable levels in source waters. Rather, it is introduced into public water supplies through internal pipe corrosion. Small amounts of lead may be used in plumbing fixtures or in older solder compounds for copper pipe. Therefore, the LCR required sampling to be conducted at consumer taps.

Recently, the public across the U.S. was alarmed by the experience in Flint, Michigan, where a change in water sources without proper evaluation of corrosion control treatment resulted in higher corrosion rates, leading to higher lead levels. This problem was compounded by the failure of some or all of the city, state, and federal employees and regulators to take action. Primarily as a result of this highly publicized incident, the EPA implemented short-term changes to the LCR and proposed additional long-term changes. The short-term changes were the following:

- Changes to sampling procedures: no pre-flushing, no removal of aerators, run water as if filling up a glass to drink when collecting sample (not at low flow), use wide mouth bottles.
- Complete materials inventory—including lead service line locations and lead plumbing material in the distribution system. Remove all lead lines. Update maps to show lead locations.
- Improve transparency: post all lead and copper results. Update website with lead information. Conduct public outreach. Collaborate with other organizations.
- Re-evaluate high risk sample locations.
- Optimize corrosion control treatment to minimize the leaching of metals into the drinking water (the intent of the LCR).

EPA's proposed long-term changes to the LCR included the following:

- Separation of lead and copper sampling from one another, meaning they may have different location and frequency requirements.
- For those systems with water quality that is susceptible to copper corrosion, they may need to monitor at newly constructed houses or conduct pipe loop tests.
- Broaden the extent of lead monitoring sites. The current LCR provides a good overview of corrosion rates and lead levels, but there is concern that it may overlook some locations with high levels.
- Depending on monitoring results, a system may need to develop an optimal corrosion control plan and receive approval for the plan from the state. The plan may require review and approval every few years.
- Remove all lead pigtail lines by 2050.
- Increase monitoring.

The City's monitoring results for lead and copper have complied with current standards. The system is currently required to conduct sampling at 20 homes, based on age and construction materials, once every 6 months. The last monitoring was conducted in April 2017. The results showed a 90^{th} percentile lead level of 0.00 mg/L (below laboratory detection limit) compared to the lead action level of 0.015 mg/L. The 90^{th} percentile copper level was found to be 0.034 mg/L, below the copper action level of 1.3 mg/L.

Between 1992 and 2017, the City of Albany reported the 90^{th} percentile lead level above the 0.015 mg/L action level in June 2006, December 2006, and June 2007. During that same period, Albany never reported the 90^{th} percentile copper level above the 1.3 mg/L action level.

4.2.3 Distribution System Regulations

Oregon's rules include the following specific requirements related to the distribution system:

- Distribution piping shall be designed and installed so that the pressure measured at the property line of any user shall not be reduced below 20 pounds per square inch (psi).

- Wherever possible, dead ends shall be minimized by looping. Where dead ends are installed, blow-offs of adequate size shall be provided for flushing.
- Wherever possible, distribution pipelines shall be located on public property. Where pipelines are required to pass through private property, easements shall be obtained from the property owner and shall be recorded with the county clerk.
- Wherever possible, booster pumps shall take suction from reservoirs to avoid the potential for negative pressures on the suction line, which could result when the pump suction is directly connected to a distribution main. Pumps that take suction from distribution mains shall be provided with a low-pressure cutoff switch on the suction side set at no less than 20 psi.

4.3 Emerging Drinking Water Regulations

The EPA continues to review existing regulations for possible revisions and to examine potential drinking water contaminants for possible regulation. The newest regulation issued by EPA is the Revised Total Coliform Rule, which eliminated an MCL for total coliform but kept the MCL for *Escherichia coli*, which has been found to be a better indicator than total coliform of the microbiological safety of drinking water. A total coliform positive now triggers system evaluation requirements rather than an MCL violation. This rule has no significant impacts on the City's operations.

4.3.1 Algal Toxins

Oregon has issued Health Advisories for cyanotoxins, also known as algal toxins, which are toxins introduced into water supplies by cyanobacteria blooms. Cyanobacteria are photosynthetic bacteria, formerly known as blue-green algae. The State of Oregon issued Health Advisories for algal toxins and EPA released similar Health Advisories in June 2015. Health Advisories are non-regulatory values that serve as informal guidance to assist state regulatory agencies and managers of public water systems in their role of protecting public health.

EPA issued Health Advisories for microcystin and cylindrospermopsin as follows:

- For children under 6 years of age, the 10-day Health Advisories levels are 0.3 µg/L for microcystin and 1.6 µg/L for cylindrospermopsin
- For children 6 years and above and adults, the 10-day Health Advisory levels are 0.7 µg/L for microcystin and 3.0 µg/L for cylindrospermopsin

On August 7, 2015, President Obama signed into law the Drinking Water Protection Act that amends the Safe Drinking Water Act with the intent to control harmful algal blooms in drinking water. The legislation required EPA to submit a plan to Congress by November 2015 to evaluate algal toxins' risk to human health and to recommend feasible treatment options to mitigate any adverse public health effects. EPA's plan was essentially a compilation of ongoing and planned research needs, noting that many questions remain about occurrence levels, health effects, and treatment approaches.

The EPA has listed three algal toxins on the Candidate Contaminant List 3: anatoxin-a, microcystin-LR, and cylindrospermopsin. According to EPA's current timetable, regulations for algal toxins will not occur until 2025. However, EPA's Administrator has the authority to issue an emergency regulation if circumstances warrant such action.

The World Health Organization has established a health-based drinking water guideline of 1.0 part per billion (ppb) for one algal toxin, Microcystin-LR. The Australian standard is 1.3 ppb for total microcystins, while Health Canada has proposed a similar standard of 1.5 ppb for total microcystins.

The OHA Drinking Water Program has developed guidance for water systems that recommends monitoring for algal toxins when algal counts are above a certain level, or if a public health advisory has been issued. If algal toxins are detected in the finished water above threshold levels (microcystin > 1.6 µg/L, anatoxin-a > 3 µg/L, cylindrospermopsin > 3 µg/L and saxitoxin > 1.6 µg/L), the guidance says to issue an immediate “Do Not Drink” public notice.

Detroit Lake, on the North Santiam River, is the only location noted by OHA upstream of the City that has harmful algae blooms. The lake is approximately 49 river miles upstream of the City. OHA has not noted any algae blooms upstream on the South Santiam River.

4.3.2 Cybersecurity

One other regulatory area that may have implications for water utilities is cybersecurity. Cyber-criminals have invaded highly secured federal and private networks, such as the U.S. State Department and Sony Corporation, so the vulnerability of water utilities is certainly a legitimate concern. To date, water utilities have not been a target of terrorist cyber-attacks; it is uncertain if they will become a target in the coming years.

The federal Critical Infrastructure Partnership Advisory Council (CIPAC) issued the Water Sector Cybersecurity Strategy report in April 2015. The AWWA has since issued guidance and tools to support the water industry’s voluntary application of the CIPAC recommendations. The City is not required to take cybersecurity actions, but it would be prudent to monitor AWWA’s continuing efforts in this field.

4.3.3 Contaminants of Potential Concern

Since the 1980s, researchers have investigated the occurrence of traces of inorganic and organic contaminants in water. These contaminants, called contaminants of potential or emerging concern (CPC) or microconstituents, include industrial chemicals, metals, natural or synthetic hormones, pharmaceuticals, household chemicals, and personal care products. Very few studies have investigated the effect of these trace contaminants on human health. The contaminants of greatest current concern are a class of compounds called endocrine disruptors. Endocrine disrupters have been shown to cause adverse effects in a variety of animal species. Only some of the CPCs are endocrine disrupters.

CPCs enter source water from both point (effluent pipe) and non-point (overland runoff) sources. There are some, but limited, municipal dischargers upstream of the A-M WTP withdrawal point. Upstream municipal dischargers include Sweet Home, Lebanon, and Stayton.

4.3.4 Source Water Protection

The LT2ESWTR does not mandate source water protection measures for the City, but watershed protection should be considered by Millersburg and Albany.

A watershed protection program could include:

- Characterizing the watershed hydrology and land ownership.
- Identifying the watershed characteristics, including soil types, contaminant sources, and other factors that affect water quality.
- Identifying watershed activities that have or may have an adverse impact on water quality.
- Monitoring the occurrence of activities that may have an impact on source water quality. This may include water quality monitoring as well as identifying and performing field assessments of activities.

4.4 Monitoring Requirements and Schedule

The City fulfills the monitoring requirements of the state and federal regulations. Table 4-2 summarizes the current water quality monitoring schedule for the City. Other monitoring may also be required as the EPA and the state adopt new drinking water regulations in coming years.

Table 4-2. Monitoring Schedule
City of Millersburg Water System Master Plan

Parameter	Minimum Frequency	Number of Samples
Coliform Bacteria	Monthly	2
Disinfectant By-products	Quarterly until reduction granted	1
Lead and Copper	Every 6 months until reduction granted	20
Asbestos	Every 9 years if present in the distribution system	1
Chlorine Residual	2/week	1

Service Goals and Policies

5.1 Level of Service Goals

The City's level of service goals are summarized in Table 5-1. The criteria presented in this table provided a basis for evaluating the performance of the distribution system as discussed later in this report.

Table 5-1. Level of Service Goals
City of Millersburg Water System Master Plan

No.	Item	Millersburg Criteria	Regulations or Published Criteria
1	Fire flows for low density (single-family and duplex) residential areas (structures < 3,600 square feet in area)	1,000 gpm for 1 hour (storage of 60,000 gallons)	Oregon Fire Code: single-family residential, requires 1,000 gpm/1 hour for houses up to 3,600 square feet in area. Up to 1,500 gpm/2 hours for houses larger than 3,600 square feet in area. For other building types, see Table B105.2[1] ISO: no insurance penalty if at least 1,000 gpm for 2 hours is available. ISO downgrades a community's insurance rating unless at least 3,500 gpm is available for 3 hours for habitational buildings such as schools, care centers, and light commercial.
2	Fire flows for medium and high-density multi-family residential areas (structures > 3,600 square feet in area)	1,750 gpm for 2 hours (storage of 210,000 gallons)	
3	Fire flows for care/assisted living centers, schools, commercial, and industrial areas	5,000 gpm for 4 hours (storage of 1,200,000 gallons).[1]	
4	Hydrant spacing	500-ft average spacing between hydrants in residential areas. 300-ft average spacing between hydrants in industrial areas.	Oregon Fire Code: Per Table C105.0, average spacing for 1,750 gpm or less fire flow is 500 ft. For higher fire flows, see table for average hydrant spacing ISO: no insurance penalty if hydrants kept to 1,000 feet maximum spacing.
5	Distribution piping: sizes and looping	Line flow velocity < 10.0 fps or head loss below 10.0 ft/1000 ft of pipeline under PHD.	Oregon: wherever possible, dead ends shall be minimized by looping. Where dead ends are installed, blow-offs of adequate size shall be provided for flushing.
6	Transmission mains (≥ 12-inch): sizing	Maintain flow velocity < 7.0 fps under MDD.	
7	Operating pressures	35 psi to 100 psi under PHD. Maintain minimum of 20 psi for fire flows, during MDD.	Oregon: minimum allowable pressure is 20 psi at the property line
8	Equalization storage volumes: residential only	20% of MDD.	No Oregon requirements. Only general guidance is provided by states, indicating that equalization storage should consider city-specific daily use patterns. The 20% is based on City's demand records.
9	Emergency storage volumes	1 x ADD	No Oregon requirements.

Table 5-1. Level of Service Goals
City of Millersburg Water System Master Plan

No.	Item	Millersburg Criteria	Regulations or Published Criteria

[1]Table B105.2 includes flows of up to 8000 gpm for 4 hours. 5000 gpm for 4 hours was chosen for Millersburg criteria based on building types and sizes, as well as requirements for sprinklers and fire alarms at many industrial facilities currently located within the city.

fps = feet per second

ft = feet

ISO = Insurance Services Office

Distribution, Transmission, and Storage Evaluation

This section contains an analysis of the City's transmission and distribution system, and finished water reservoir. A computer model of the system was developed to model the current system and recent water demands, and was used to review the performance of the distribution system.

The distribution system was analyzed using standard water system criteria. It must be capable of supplying water to all locations at acceptable pressures during:

- PHD condition
- MDD with fire flow condition

A PHD condition represents the highest expected demands that the system needs to supply, being defined as the highest demand hour on the maximum day. Evaluating the ability of the system to supply fire flows during an MDD condition is a typical approach used for evaluating fire flows. It represents a condition of delivering adequate flows to fire hydrants during a summer day.

6.1 Storage

Storage in the distribution system is provided to meet the following three needs:

- Equalization: storage to meet peak demands
- Fire: storage required for fire fighting
- Emergency: storage that provides a reserve for system failures

Storage tanks are not divided into separate sections for the various components, but a review of storage needs using these divisions is helpful for determining how much storage is needed.

Another factor in determining storage size is water quality. Even when treated water meets all regulations and is aesthetically pleasing, storage of this water for an extended time can result in a deterioration of its quality. Long detention periods can impart an unpleasant taste and odor, or allow bacteriological growth. Therefore, sizing and design of storage reservoirs must also consider water quality.

6.1.1 Equalization

The amount of equalization storage needed varies from system to system, depending on factors such as the proportion of commercial to residential users, climate, and typical lot size. One of the primary water uses that affect equalization storage needs is irrigation. For communities with large irrigation use, the peak hour rate can be more than two times the maximum day rate. In the absence of specific data, it is recommended that typical criteria be applied. Equalization values in the Pacific Northwest range from 18 to 35 percent of the MDD. A value of 20 percent is a reasonable estimation for the City's system.

6.1.2 Fire

Oregon's public water system rules stipulate that finished water storage be increased if the system includes hydrants, as the City's system does. The ISO establishes rates to provide a basis for determining the storage needed for fire-fighting. This recommended rate of 5,000 gpm for 4 hours equals a storage volume of 1,200,000 gallons for commercial areas and 1,750 gpm for 2 hours (210,000 gallons) for residential areas.

6.1.3 Emergencies

Sizing finished water storage for emergencies is the most subjective among the storage volume criteria. It depends on how vulnerable the water system is to failure. In the City's case, the factors to consider include the source water quality, operation of the A-M WTP, the raw and finished water pumping, and the transmission pipeline from the finished water reservoir.

Raw water quality problems, A-M WTP operational problems, or failures of the raw or finished water pumping systems could all require times of 24 hours or longer to repair. Therefore, it is recommended that storage provide at least 24 hours of ADD volume to protect against these failures.

6.1.4 Storage Needs Analysis

Table 6-1 summarizes estimated storage needs for distribution equalization, fire, and emergency needs. Using this approach, it does not appear that additional storage is needed to meet these needs in the 20-year planning period. A surplus is projected through the end of the 20-year planning period. The equalization and emergency volumes depend on demands, and, if demand growth exceeds the projected rate, additional storage for these needs may be required within the next 20 years.

Table 6-1. Storage Needs Analysis
City of Millersburg Water System Master Plan

			Storage Needs (MG)				Storage Evaluation (MG)	
Year	**ADD (mgd)**	**MDD (mgd)**	**Equalization**	**Fire**	**Emergency**	**Total**	**Existing**	**Surplus (+) or Deficit (-)**
2017	0.85	1.48	0.30	1.20	0.85	2.35	2.85	+0.50
2037*	1.22	2.12	0.42	1.20	1.22	2.84	2.85	+0.19

*Storage requirement projections do not include any industrial growth.

6.2 Distribution Piping Analysis Approach

A distribution system network model was developed and used to analyze the capability of the system to provide adequate flows and pressures, both for the existing system under current water demands and for projected future demands. The modeling was performed using InfoWater software, which is a geographical-information-system-integrated water distribution modeling application using the EPANET computation engine, which was developed by EPA to perform extended period simulation of hydraulic and water quality behavior within pressurized pipe networks.

6.2.1 Existing System Analysis

The existing system was evaluated for an MDD of 1.48 mgd and a PHD twice that value. The ability of the system to supply fire flows during an MDD was checked, while maintaining a minimum pressure of 20 psi in all parts of the system. The 20-psi minimum pressure is per Oregon's drinking water rules.

The existing system performed acceptably for providing peak hour flows with adequate pressures. The system also provided fire flows that met the City's level of service goals during the MDD. See Appendix A for modeling results for the existing system.

6.2.2 Future System Analysis

The future, year 2037, system was evaluated for an MDD of 1.93 mgd and a PHD twice that value. In addition, the future system was checked to confirm that it will be able to supply fire flows during a MDD while maintaining a minimum pressure of 20 psi in all parts of the system. The 20-psi minimum pressure requirement is per Oregon's drinking water rules.

Modeling showed that the future system will be able to provide adequate flows with one exception: it may not be able to provide sufficient fire flows during the maximum day condition to fire hydrants along Steelhead Run Drive.

6.3 Recommended Storage and Distribution System Improvements

The following recommendations were developed by examining storage and distribution needs:

- Perform hydrant flow test at east end of Steelhead Run Drive to verify model results. If flow is less than required fire flows upsize the 8-inch-diameter pipe along Steelhead Run Drive as required to meet fire flows.
- Replace approximately three services off the asbestos cement pipe along Old Salem Road north of the Truax Creek Bridge with connections to the 20" DI main along Old Salem Road and abandon the remaining asbestos cement pipe in this area.
- Replace approximately 15 services off the asbestos cement pipe along Old Salem Road south of the Truax Creek Bridge with connections to the 20" DI main along Old Salem Road and abandon the remaining asbestos cement pipe in this area.
- As new industrial or commercial customers develop in unserved or underserved areas of the City, evaluate and upsize or expand the water distribution system as necessary to accommodate growth. This evaluation may include consideration of additional water storage in the northern area of the City and improvements to the City of Albany intertie at the south end of the City.
- Evaluate need for additional storage capacity at the City's 20-year growth projections.

The capital improvements in this list have been captured in the capital improvements plan outlined in Section 7.

SECTION 7

Capital Improvements Plan

This section summarizes the improvements discussed in the preceding sections and presents a capital improvements plan for the City. The capital improvements plan will guide the City's investments over the coming years.

The master plan fulfills the requirements of OAR 333-061-0060 Subsection 5, which requires that community water systems maintain an up-to-date master plan. One element of the rules not provided by this plan is a description of alternatives to finance improvements. The City ought to review water rates and system development charges based on the findings of this master plan, and determine financing alternatives at that time.

Table 7-1 presents the proposed capital improvements plan for the City.

Table 7-1. Capital Improvements Plan
City of Millersburg Water System Master Plan

Project Number	Project Description	Total Estimated Project Cost*	Year
1	Upsize 940 feet of 8-inch-diameter pipe on Steelhead Run.	$180,000	2025 or sooner if needed
2	Replace approximately three services off the asbestos cement pipe along Old Salem Road north of the Truax Creek Bridge with connections to the 20-inch-diameter ductile iron main along Old Salem Road and abandon the remaining asbestos cement pipe in this area.	$75,000	2025
3	Replace approximately 15 services off the asbestos cement pipe along Old Salem Road south of the Truax Creek Bridge with connections to the 20-inch-diameter ductile iron main along Old Salem Road and abandon the remaining asbestos cement pipe in this area.	$375,000	2025
4	Additional 1.0 mgal water storage reservoir.	$1,500,000	2035

*all estimated costs are for year 2017.

Appendix A
Existing System Modeling Results

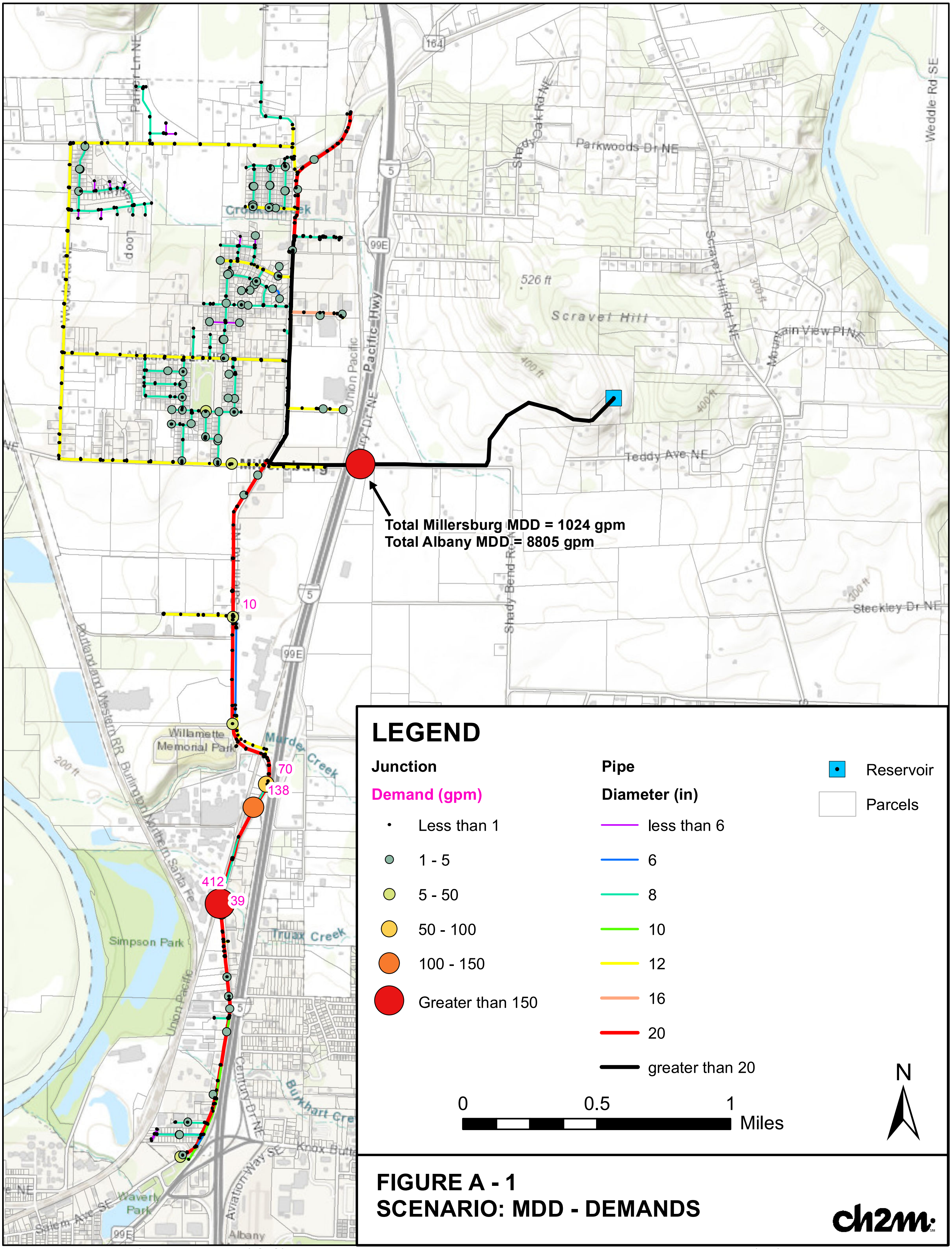


FIGURE A - 1
SCENARIO: MDD - DEMANDS

ch2m:

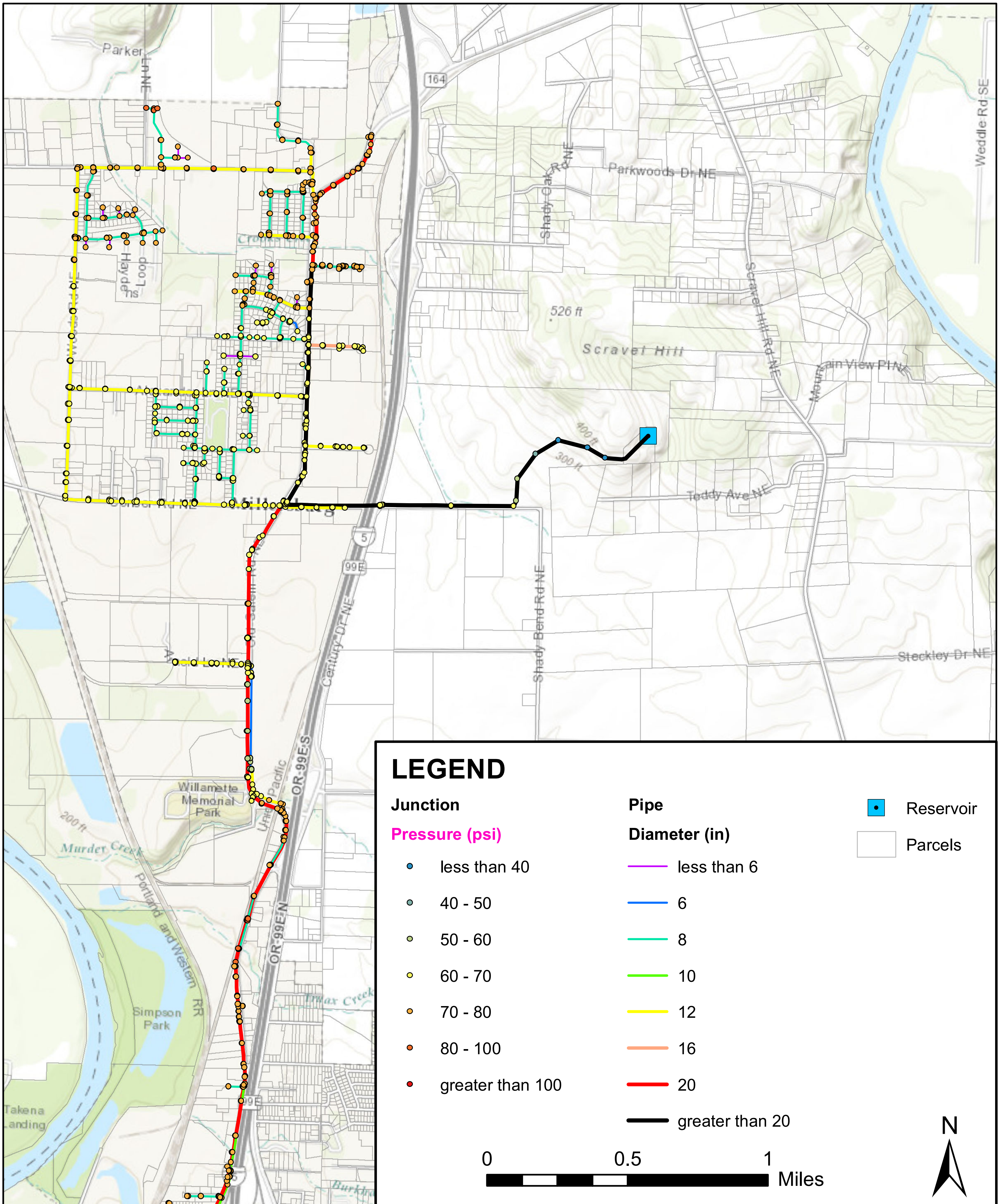


FIGURE A - 2
SCENARIO: MDD - PRESSURES

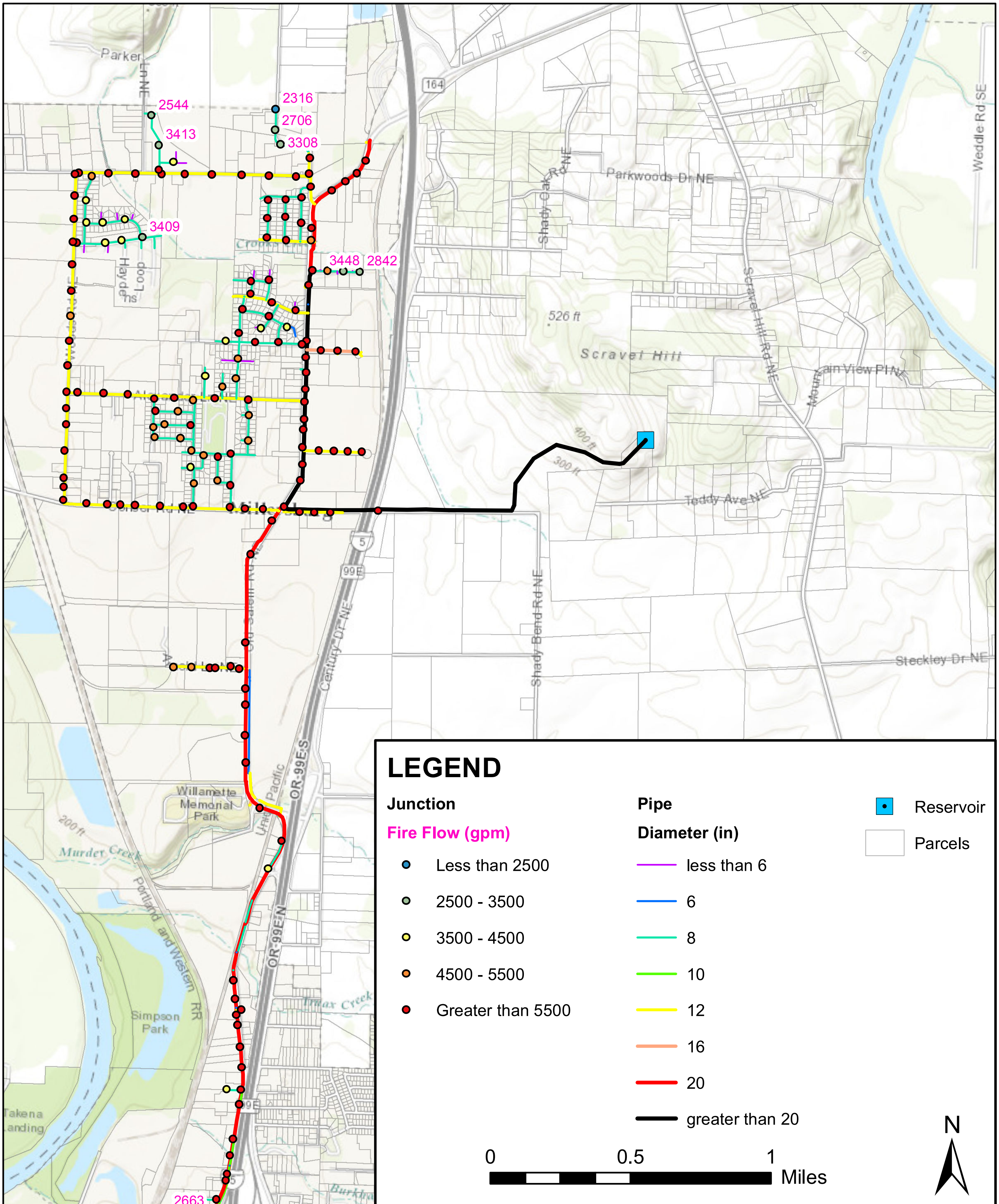


FIGURE A - 3
SCENARIO: MDD - FIRE FLOWS

ch2m:

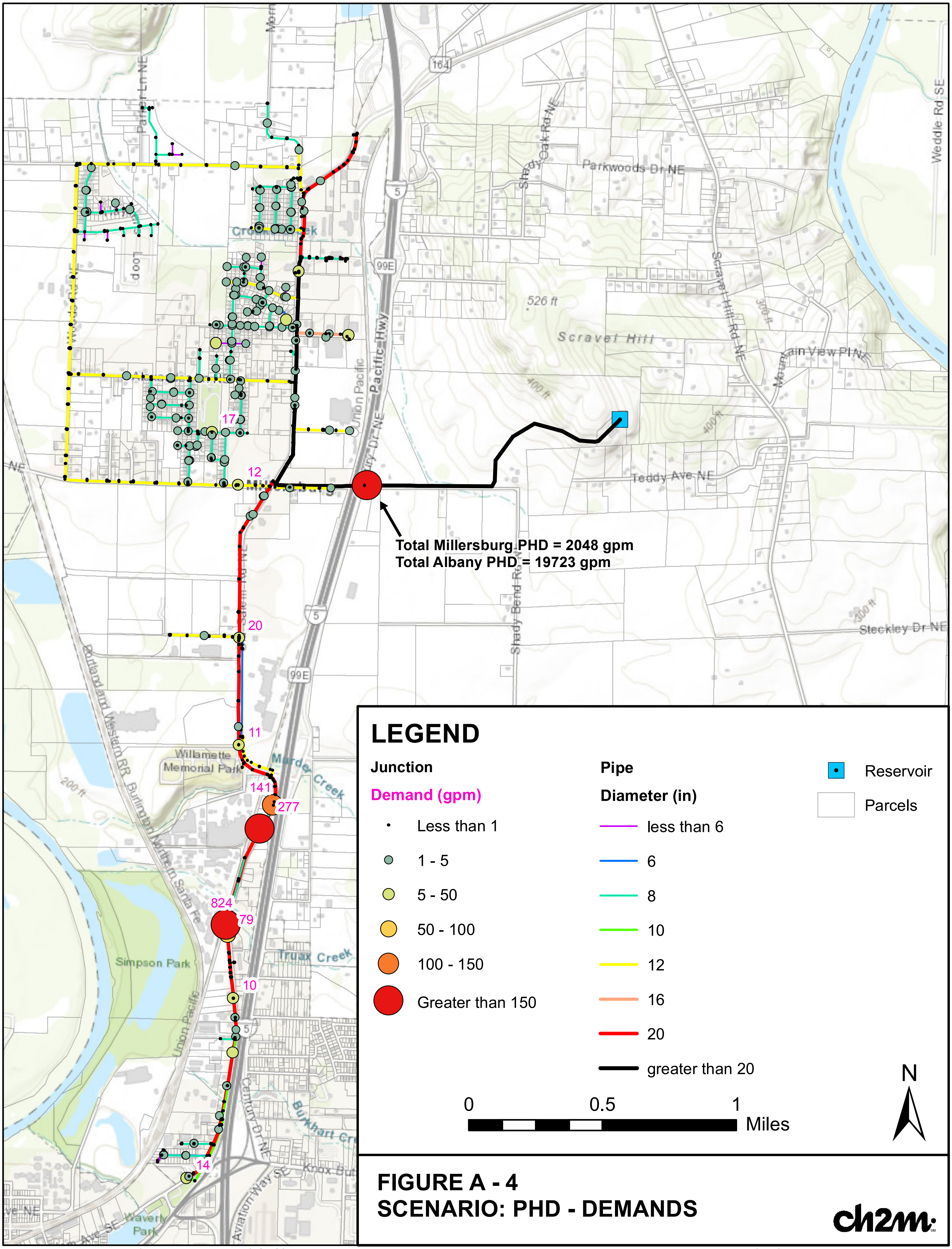


FIGURE A - 4
SCENARIO: PHD - DEMANDS

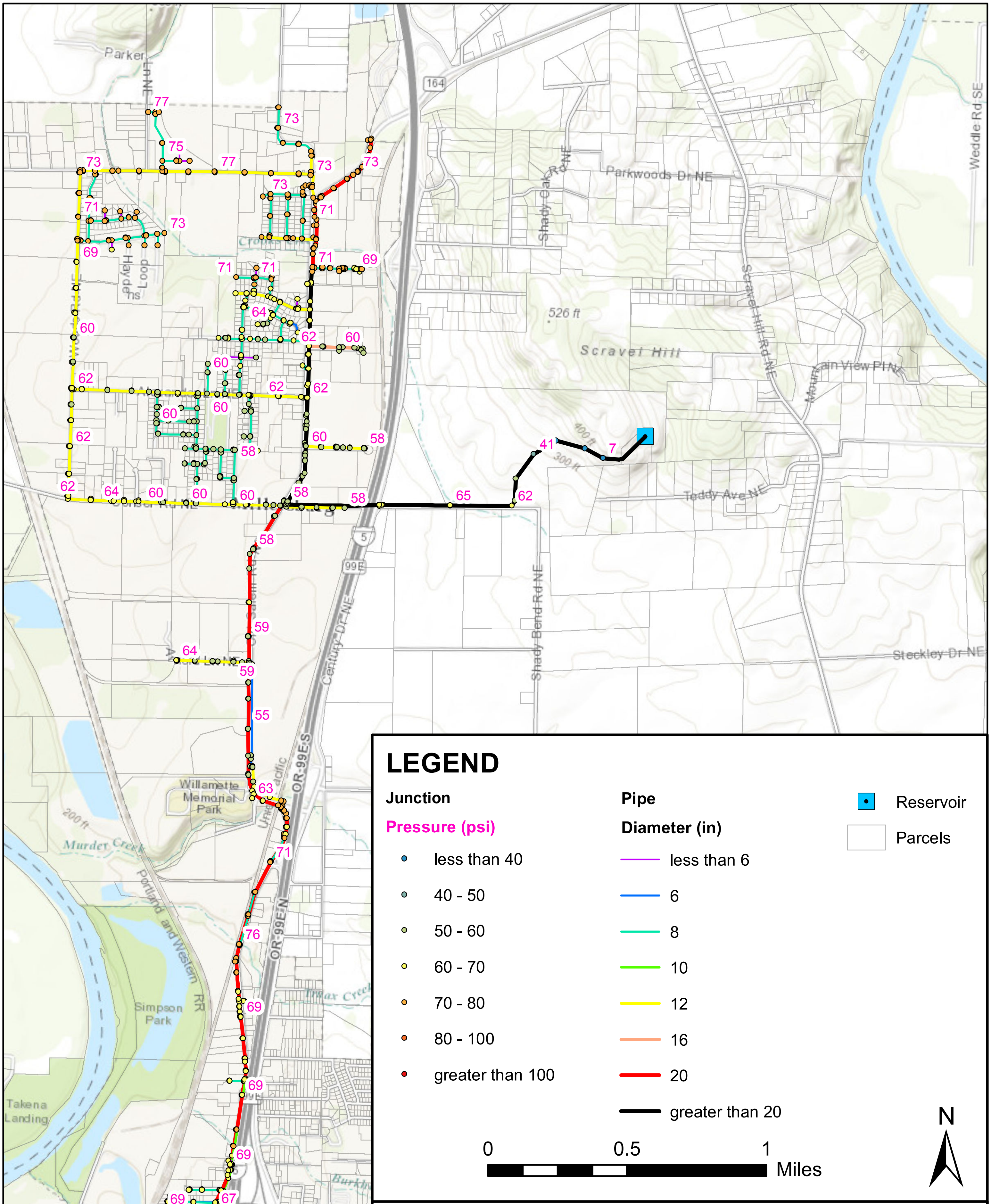


FIGURE A - 5
SCENARIO: PHD - PRESSURES

ch2m

Document Path: B:\MillersburgMP\GIS\MB_v1_PHD_Pressure.mxd Date: 10/11/2017 Time: 9:34:42 AM

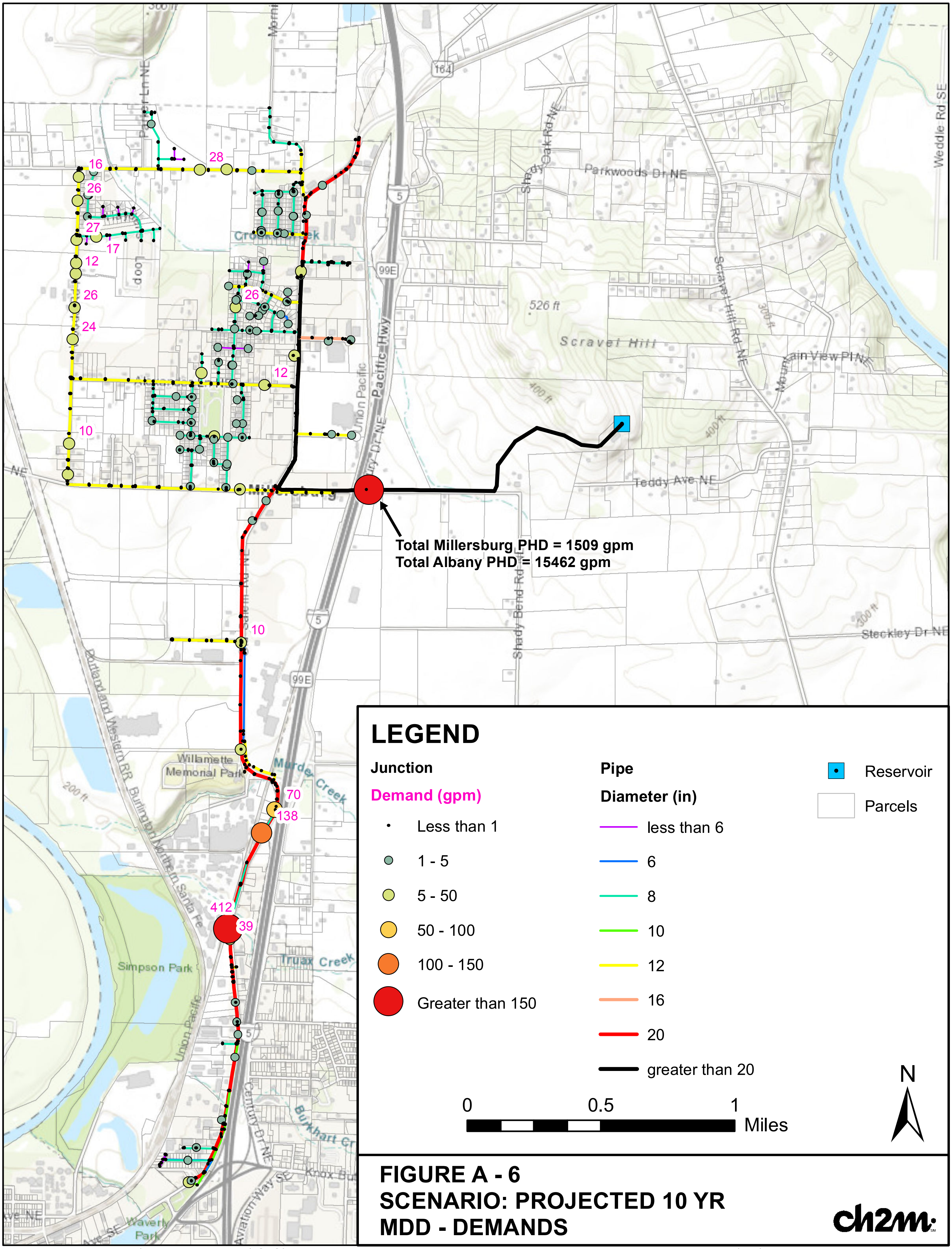


FIGURE A - 6
SCENARIO: PROJECTED 10 YR
MDD - DEMANDS

ch2m:

Document Path: B:\MillersburgMP\GIS\MB_v1_FUTURE_MDD_Demand.mxd Date: 12/11/2017 Time: 9:14:50 AM

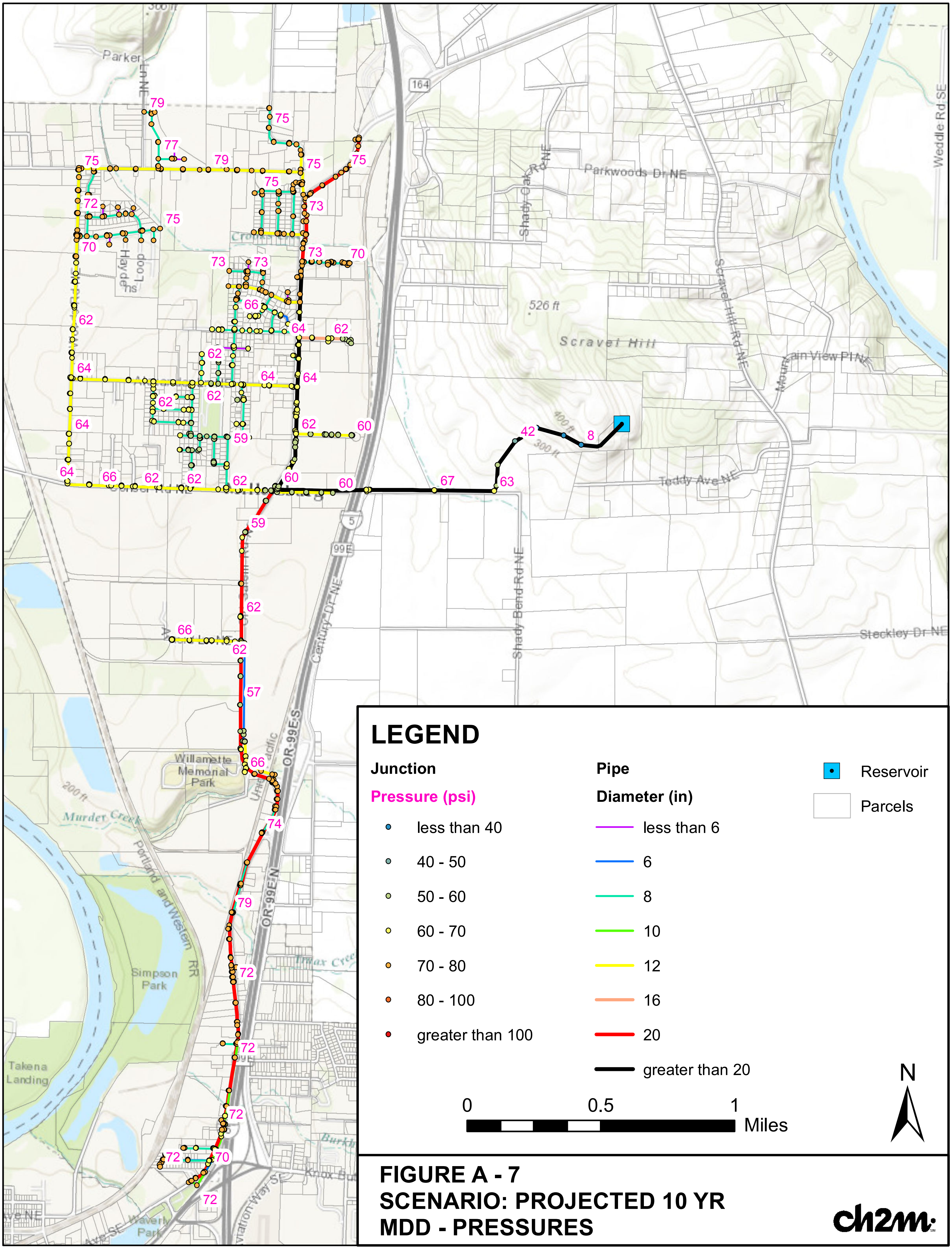


FIGURE A - 7
SCENARIO: PROJECTED 10 YR
MDD - PRESSURES

Document Path: B:\MillersburgMP\GIS\MB_v1_FUTURE_MDD_Pressure.mxd Date: 10/11/2017 Time: 9:26:49 AM

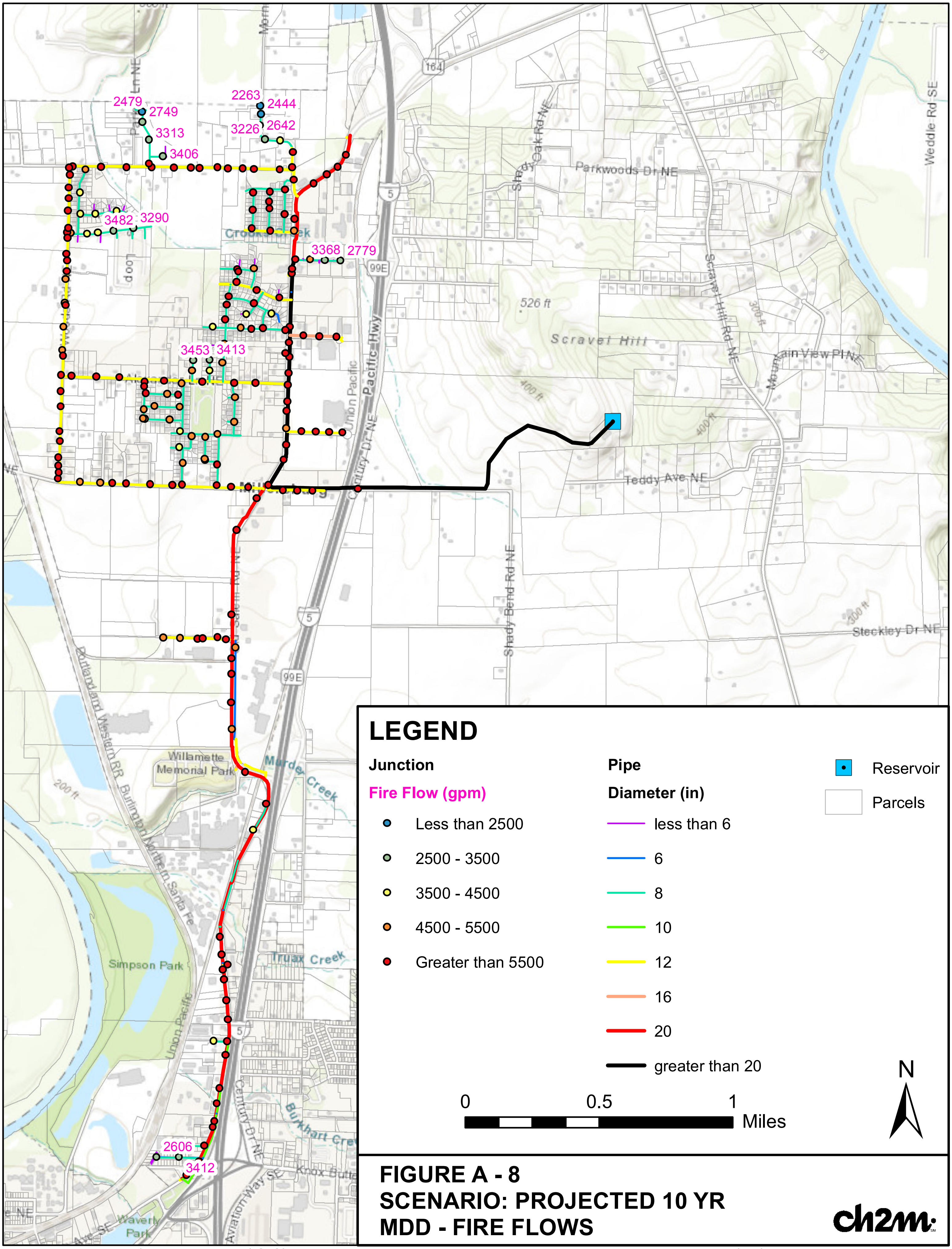


FIGURE A - 8
SCENARIO: PROJECTED 10 YR MDD - FIRE FLOWS

ch2m

Document Path: B:\MillersburgMP\GIS\MB_v1_FUTURE_MDD_FF.mxd Date: 12/18/2017Time: 10:33:20 AM

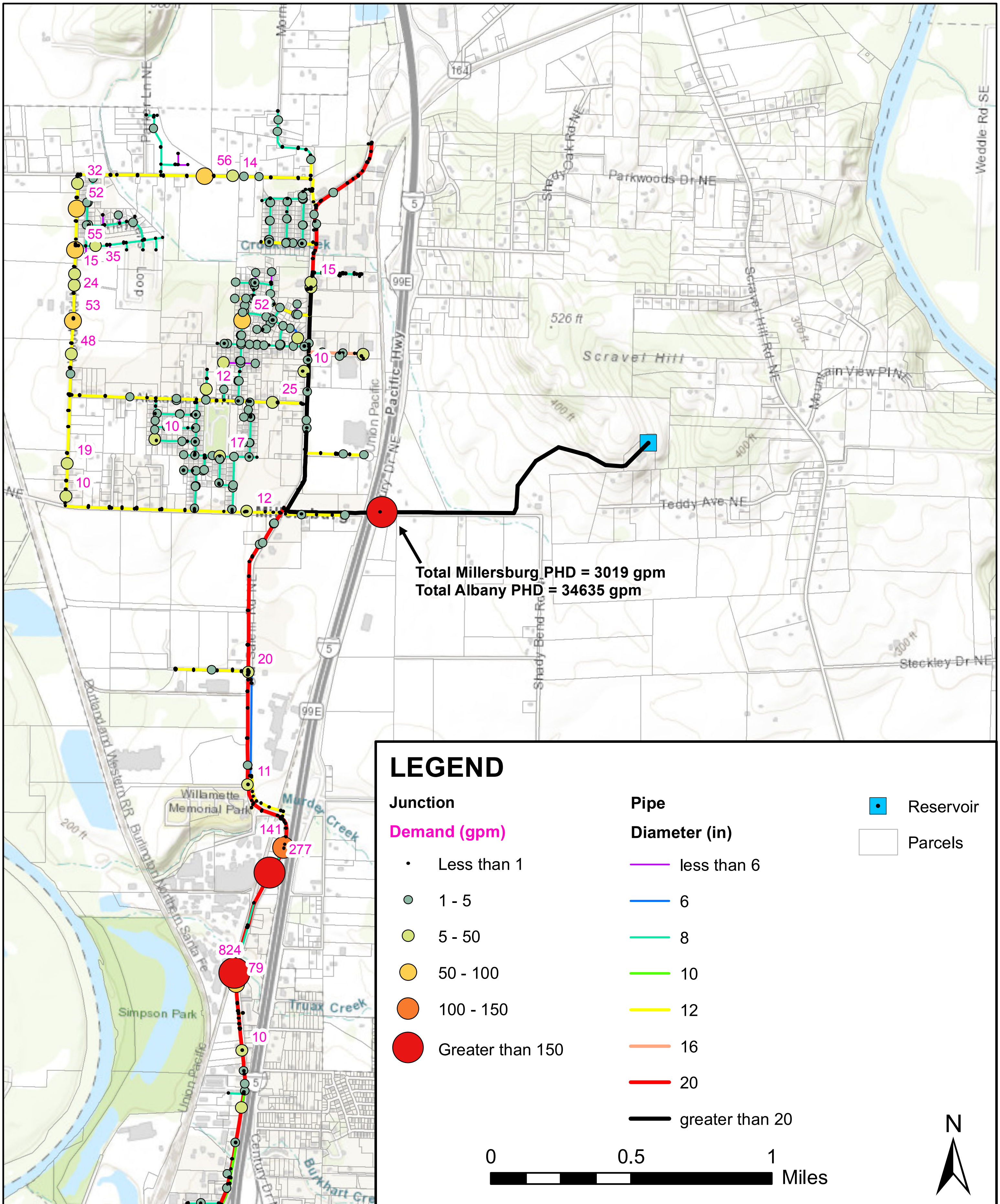


FIGURE A - 9
SCENARIO: PROJECTED 10 YR PHD - DEMANDS

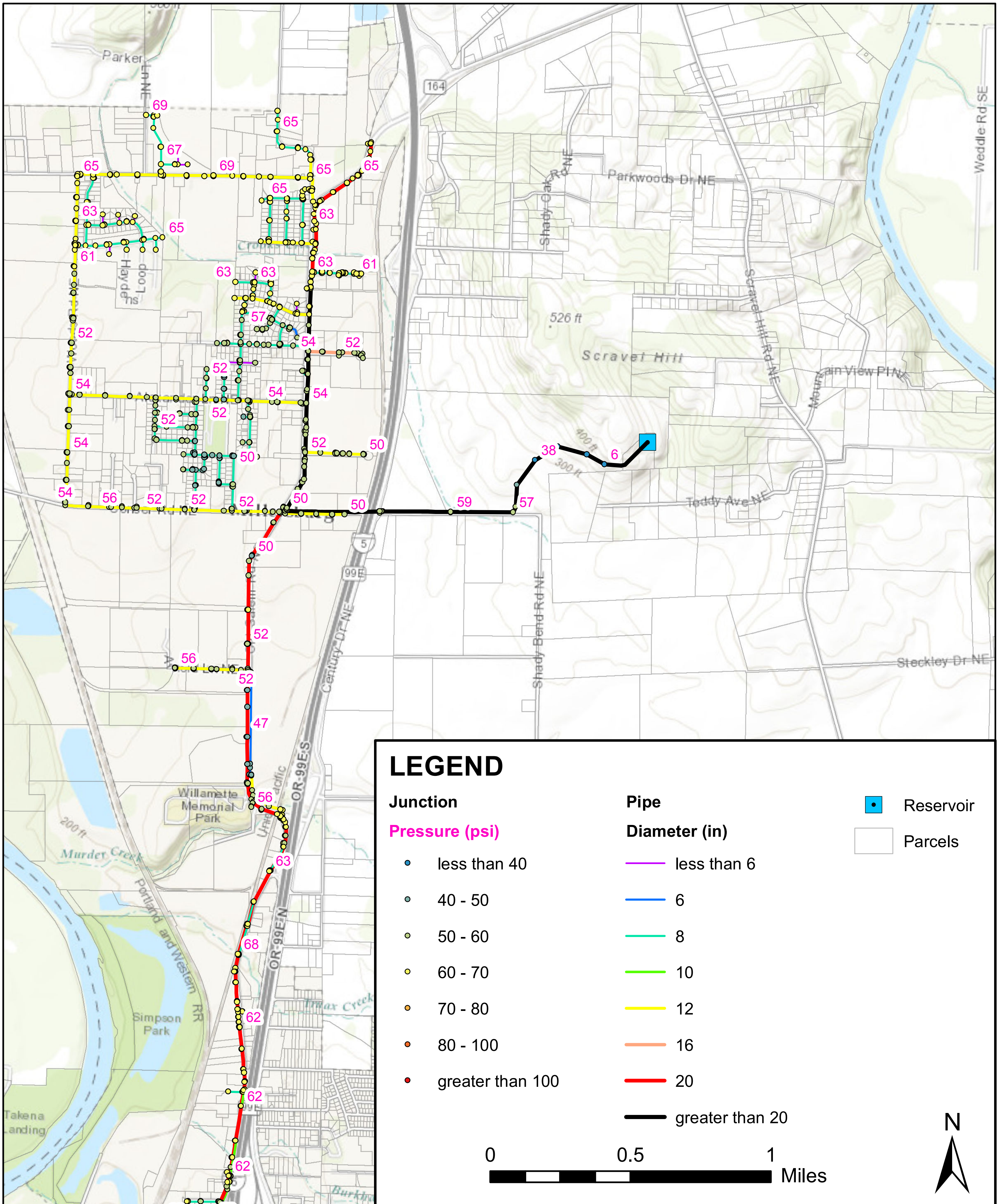


FIGURE A - 10
SCENARIO: PROJECTED 10 YR PHD - PRESSURES

ch2m

Document Path: B:\MillersburgMP\GIS\MB_v1_FUTURE_PHD_Pressure.mxd Date: 10/11/2017 Time: 9:32:10 AM

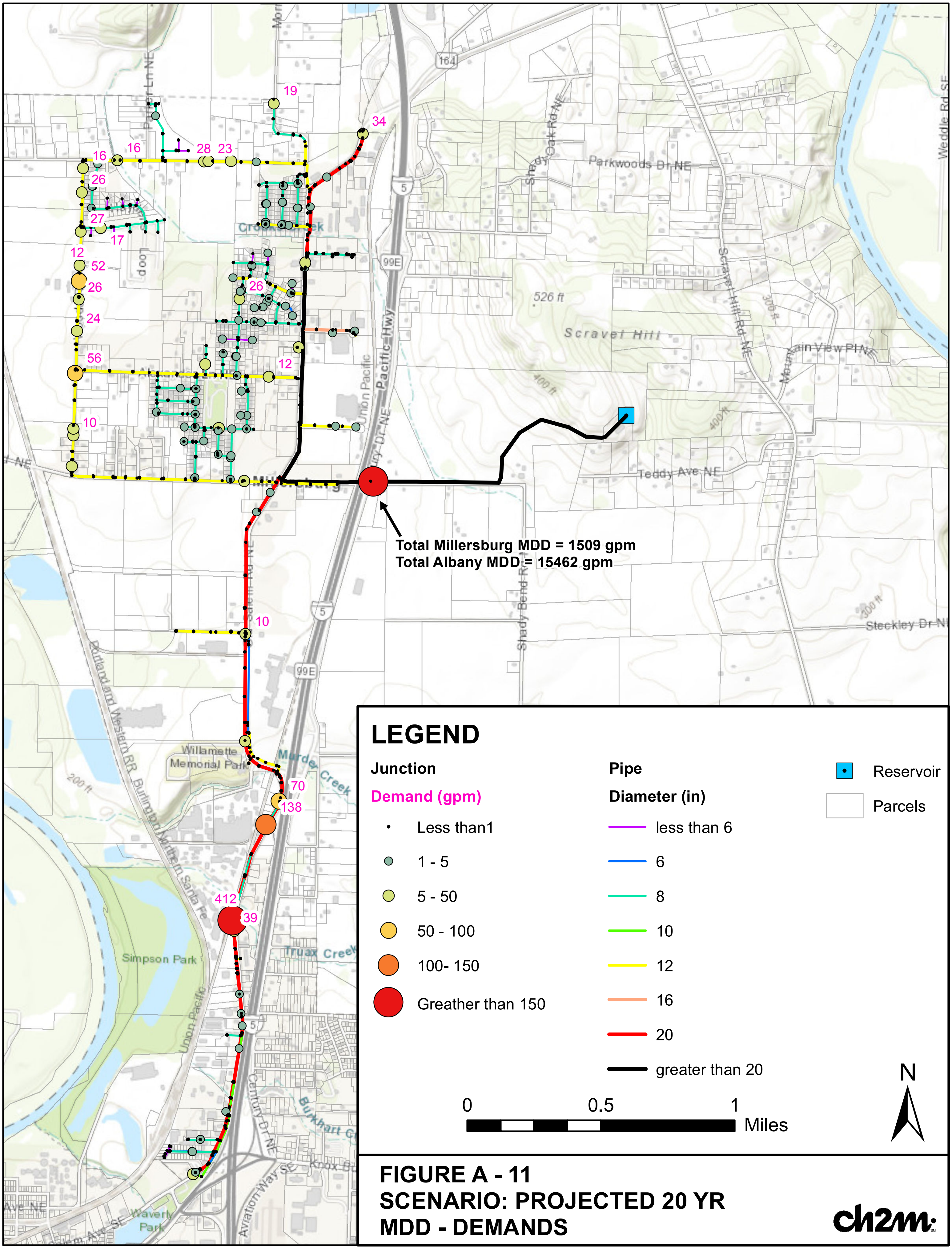


FIGURE A - 11
SCENARIO: PROJECTED 20 YR MDD - DEMANDS

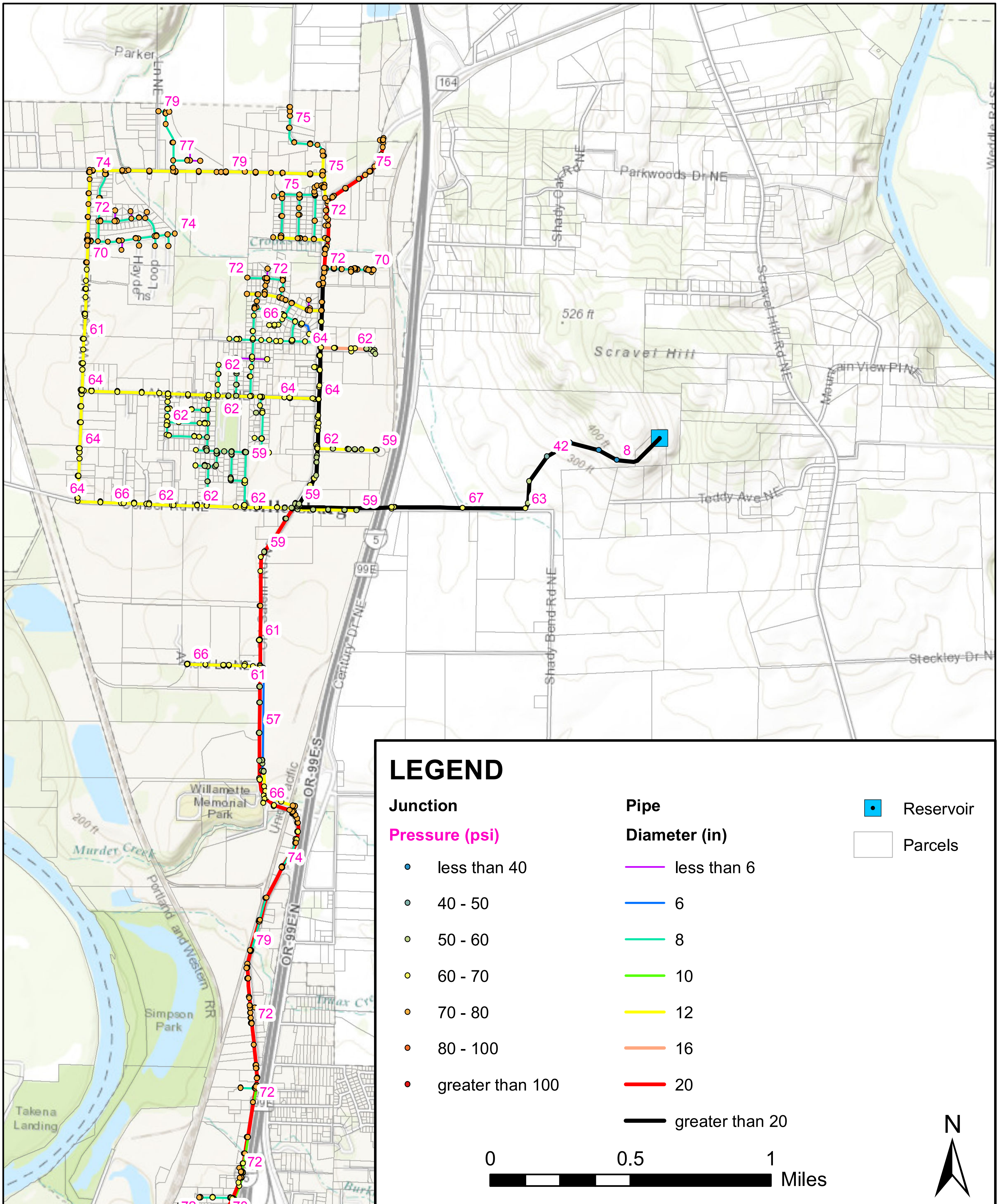


FIGURE A - 12
SCENARIO: PROJECTED 20 YR MDD - PRESSURES

ch2m

Document Path: B:\MillersburgMP\GIS\MB_v1_Buildout_MDD_Pressure.mxd Date: 10/11/2017 Time: 9:09:29 AM

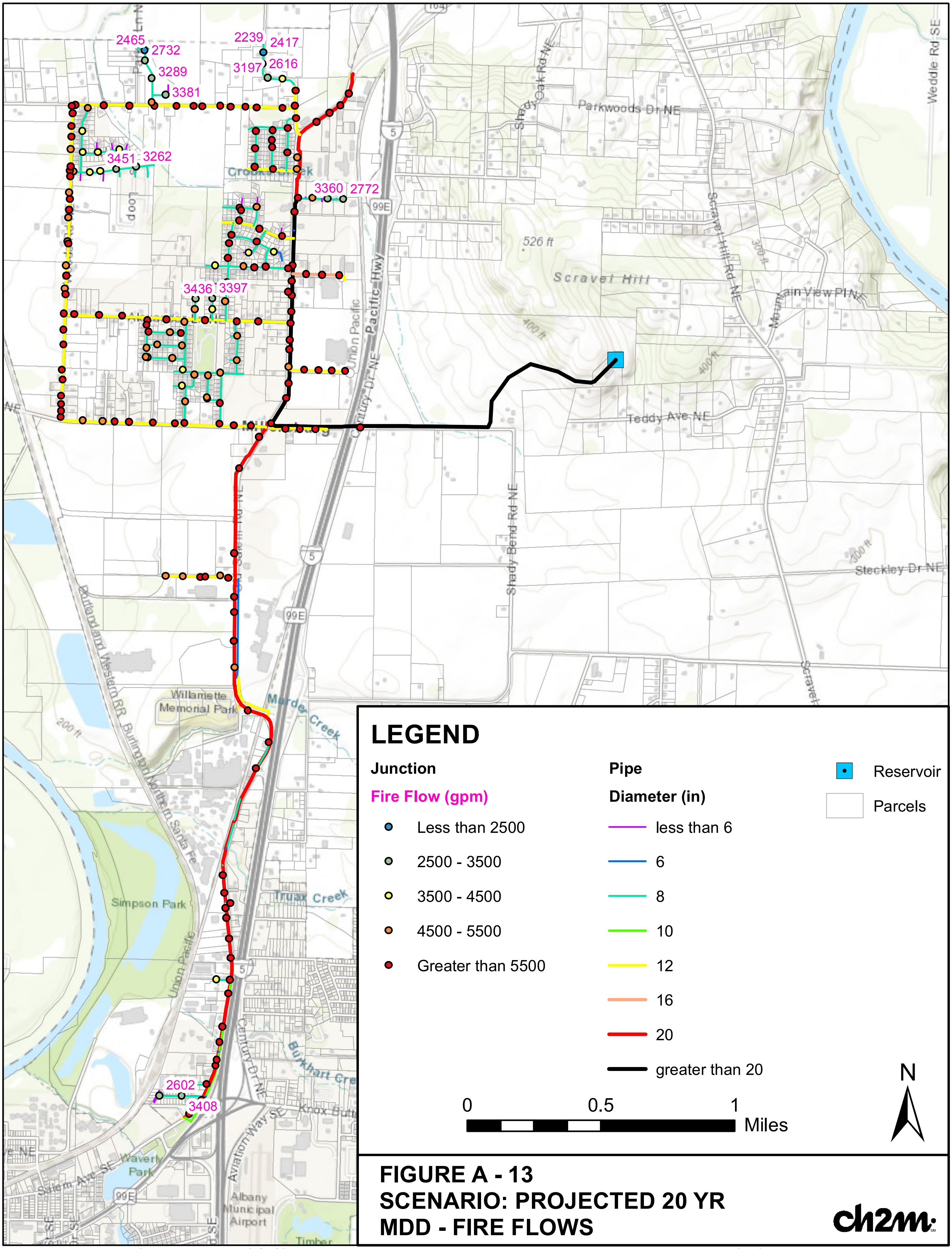


FIGURE A - 13
SCENARIO: PROJECTED 20 YR
MDD - FIRE FLOWS

ch2m

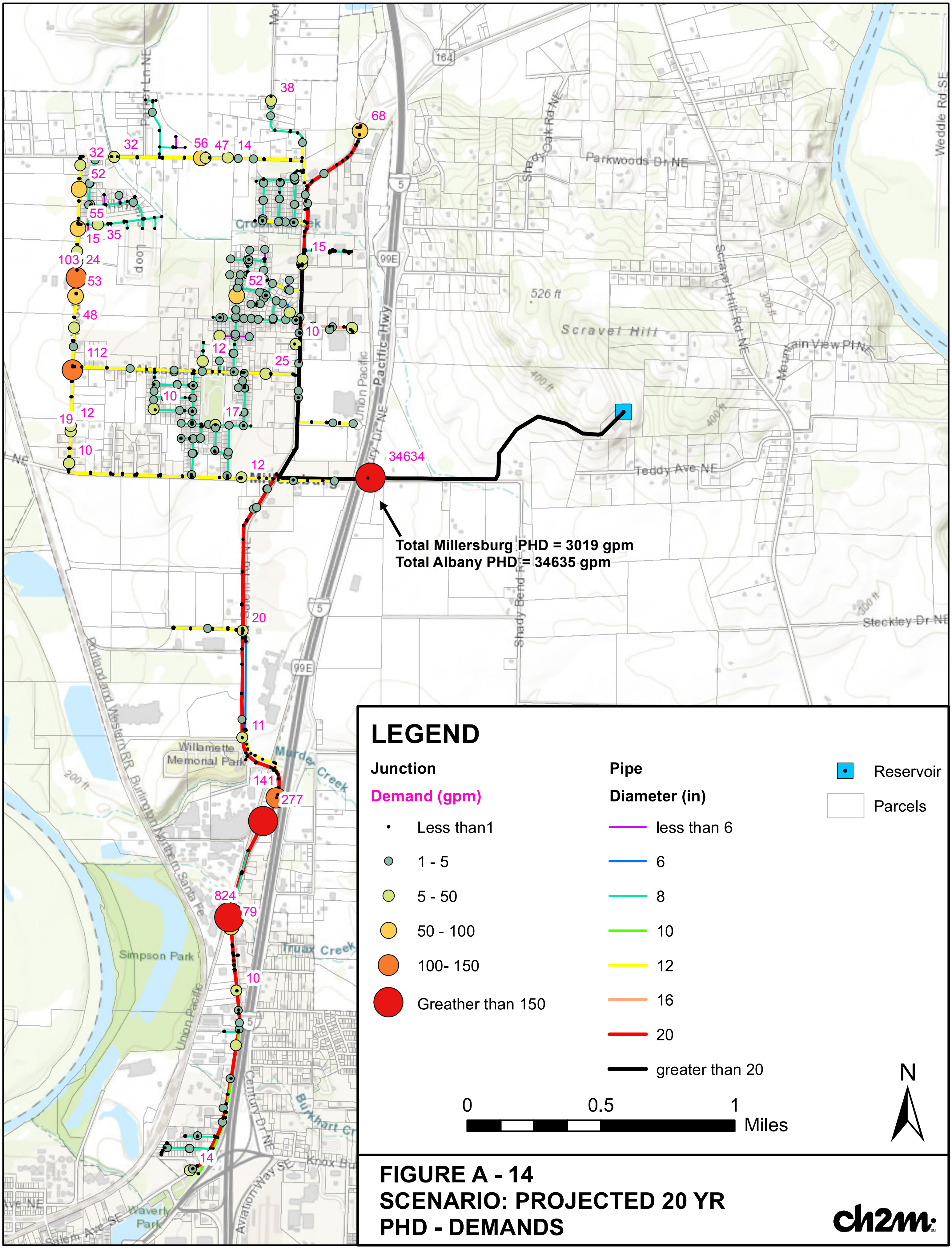
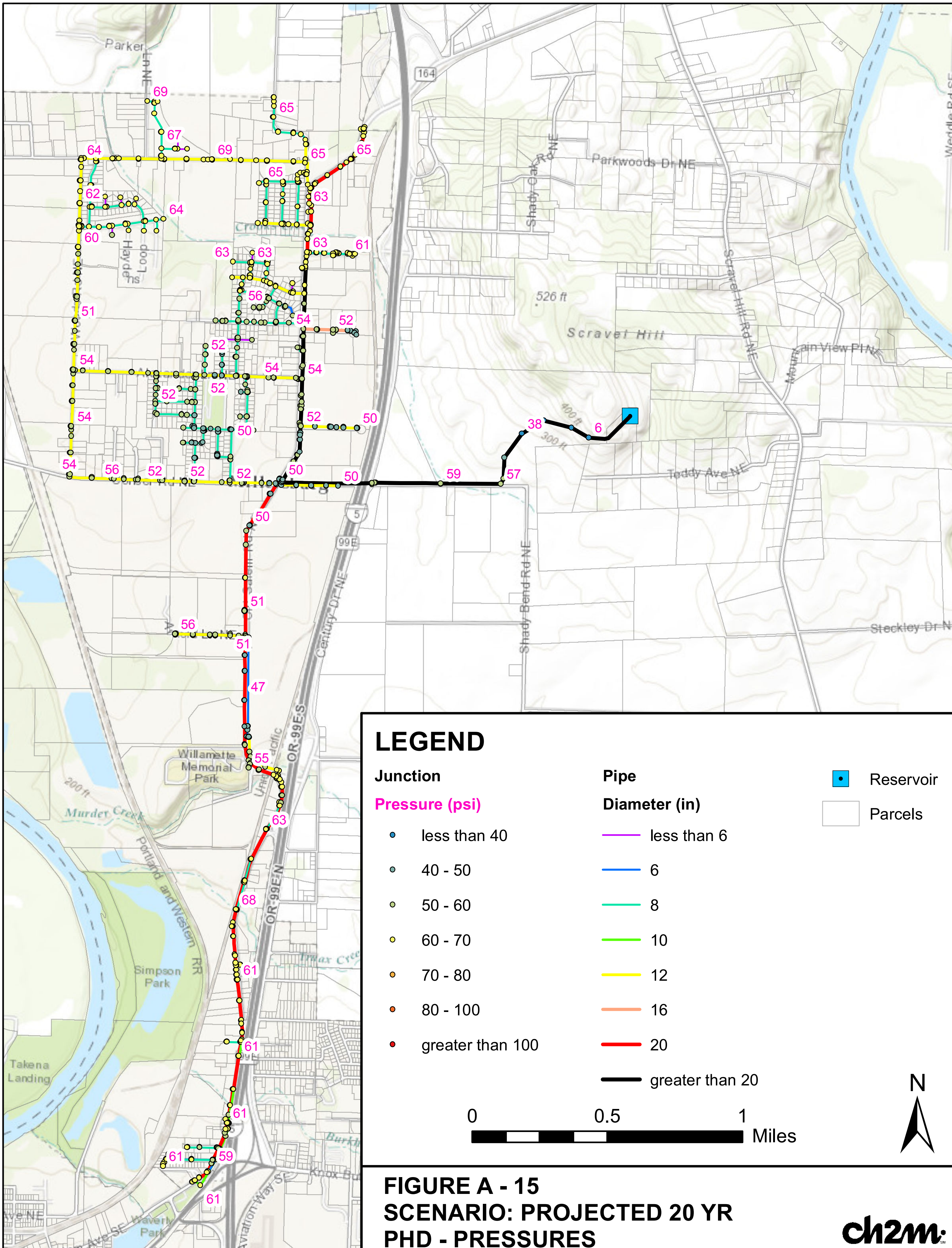


FIGURE A - 14
SCENARIO: PROJECTED 20 YR PHD - DEMANDS

Document Path: B:\MillersburgMP\GIS\MB_v1_Buildout_PHD_Demand.mxd Date: 12/18/2017 Time: 10:50:46 AM



LEGEND

Junction

Pressure (psi)

- less than 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 100
- greater than 100

Pipe

Diameter (in)

- less than 6
- 6
- 8
- 10
- 12
- 16
- 20
- greater than 20

Reservoir

Parcels

FIGURE A - 15
SCENARIO: PROJECTED 20 YR PHD - PRESSURES

ch2m

Document Path: B:\MillersburgMP\GIS\MB_v1_Buildout_PHD_Pressure.mxd Date: 10/11/2017 Time: 9:23:36 AM