Water System Plan Update
For The
Lake Limerick Water System
WSID: 44150-T

EXECUTIVE SUMMARY:

The Lake Limerick Water System (DOH ID 44150) is submitting a Water System Plan (WSP) Update. This 10-year plan amendment is required for compliance with the Washington Administrative Code. Note that this is a change from the previous 6-year planning cycle. This document will serve to provide the necessary technical information to administer and operate this system. The Lake Limerick Water System is currently an approved Group A Community water system approved for 1,250 connections. No changes are desired in the number of connections at this time.

Population:	1,967
Sources:	7 Groundwater sources totaling 944 gpm[1].
Storage:	4 Reservoirs totaling 478,800 gallons
Pressurization:	Booster pump and well pump driven
Distribution	Primarily Asbestos Cement installed in the late 1960's. Small portions of PVC installed during repairs and replacements of sections. 2,006' 2" 52,310' 4" 20,041' 6" 973' 8"
Water Rights	890 gpm, 446 acre-feet per year
ADD/ERU	212 gpd
MDD/ERU	488 gpd
Current PHD	604 gpm
20 Yr PHD	613 gpm
Fire Flow Requirements	We are working with the Mason County fire marshal to establish a system based on existing capabilities and will work to meet Mason County fire flow standards as the infrastructure is upgraded/updated. Reports from RH2 Engineering support being able to utilize the hydrants with restrictions. The additional reports are included as Appendices.
Management	LLCC Water Manager

Lake Limerick is a well-equipped system that requires some upgrades and/or modifications. There are possible significant operational, technical and/or long-term financial deficiencies at this time. The system

[1] S02 is only used for flushing and fire-fighting events due to relatively poor water quality. Without S02 total source capacity is 744 gpm.

has begun a capital reserve program to replace waterlines over the next 20 to 40 years and improve existing service levels.

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Acronyms

ADD	Average Daily Demand
C	Coefficient of Friction
DSL	Distribution System Leakage
ERU	Equivalent Residential Unit
GWI	Groundwater Under the Influence of Surface Water
HDPE	High Density Polyethylene pipe
HGL	Hydraulic Grade Line
MCL	Maximum Contaminant Level
MDD	Maximum Daily Demand
MPA	Microscopic Particulate Analysis
NTNC	Non-Transient Non-Community
PHD	Peak Hourly Demand
ppb	Parts per Billion
ppm	Parts per Million
PVC	Polyvinyl Chloride pipe
RSA	Retail Service Area
SMA	Satellite Management Agency
SWL	Static Water Level
SWSMP	Small Water System Management Program
UTC	Utilities and Transportation Commission
VFD	Variable Frequency Drive
WDM	Water Distribution Manager
WFI	Water Facilities Inventory (form)
WSDM	Water System Design Manual
WSDOH	Washington State Department of Health
WSP	Water System Plan
WUE	Water Use Efficiency

Chapter 1 System Description

1.1 Ownership and Management

The Lake Limerick water system is owned and operated by the Lake Limerick Country Club, Inc. (LLCC), a non-profit corporation chartered to care for the public amenities in the development of the same name. Water service is provided to customers in the Lake Limerick Country Club community in unincorporated Mason County, Washington. The community stretches around its namesake lake in Township 21 North, Range 3 West, W.M. and occupies Section 27 as well as portions of the southeast quarter of Section 21, the southern half of Section 22, and the southwest quarter of Section 23. Specific data about the system can be found in the Water Facilities Inventory included in Section 10.7. Pertinent information about the water system is summarized below:

Water System Name:	Lake Limerick Water
System Type:	Group A Community Water System
WSDOH ID Number:	44150-T
Location:	Mason County, Washington
Source:	Groundwater
Type of Ownership:	State of Washington Non-Profit Corporation
Service Connections:	1201 in 2020, 1224 in 2022
Population Served:	1,967 in 202,
Type of Management:	Public Water System Proprietor
Name of System:	Lake Limerick Water System
Contact:	Chris McMullen, Water System Manager
Address:	790 E. Saint Andrews Dr., Shelton, WA 98584
Phone:	(360) 426-4563

Name Backup Operator:	Northwest Water Systems
Backup Operator Contact:	Kevin Odegard, Operations Supervisor
Backup Operator Address:	PO Box 123 Port Orchard WA 98366
Backup Operator	(360) 876-0958

1.1.1 Association Responsibilities

The Lake Limerick Country Club Board of Directors, composed of nine members serving 3-year terms each, manages and controls the affairs and business of the corporation and exercises ownership authority and control over all of the common properties and assets of the corporation.

To fulfill the responsibility of operating and maintaining the water system, the Lake Limerick Board of Directors created a six-member Water Committee in 1976. The Water Committee's structure and responsibilities are outlined in the Water Department Bylaws (see attachment 10.13). Terms are staggered so that two members are elected to the Water Committee each year for a 3-year term. The Water Committee monitors and administers routine financial responsibilities of the Lake Limerick water system and implements planning and capital improvements.

The Lake Limerick Country Club employs two operations staff and one office staff dedicated to the water system and serve as the on-site contacts for the Lake Limerick Water Department. The Water Manager role is currently filled by Chris McMullen.

1.1.2 PWS Responsibilities

The Lake Limerick Water System staff provide routine operation and maintenance services including 24-hour emergency response, coordination of repairs, development and implementation of the cross-connection control program, water quality monitoring, and oversight of other regulatory compliance topics. Certified operations and management services provided meet the requirements for Group A water systems.

1.2 System History and Background

The Lake Limerick Country Club (LLCC) was incorporated in 1966 as a non-profit maintenance corporation chartered to care for the public amenities in the development, located in Mason County about 5 miles northeast of Shelton WA. The land was developed as 1,397 residential lots and a nine-hole golf course in 5 divisions. A public water system was developed to supply the domestic needs of the community, with the first 4 groundwater wells drilled between 1966 and 1969, each with an associated water right. Engineering for the system was approved in June of 1968, and the LLCC board approved completion of all waterline installation in all divisions in 1970.

Waterline installation was completed in the early 1970's. small problems were fixed, initial configurations were tuned, and the system achieved normal operations by the middle of the 1970s. A letter from 1977 notes that the final cost of the system was $230,592.48, of which $31,541.89 was for well drilling and equipment, and $199,050.50 for waterline installation. The source and purpose of the note are unexplained, but are interesting historical record. In comparison, waterline replacement today is anticipated to cost approximately $5,300,000, with an additional $3,000,000 in wells, reservoirs, booster pumps and other ancillary equipment.

By the beginning of the 1980s concerns regarding system capacity induced the community to explore options for additional capacity. A groundwater resources study was commissioned recommending that the system increase its source capacity, by drilling one source into a deeper aquifer. Through the 1980's the system drilled 3 additional sources, two drilled to the upper aquifer near 150' below grade, and one to an aquifer located near 450'. The community also installed its first two reservoirs. Supplemental water rights applications were filed for 2 of the 3 sources in the 1980s, with a third application filed in 1997 for Well 3B. All of the water rights except the application for Well 3B have been perfected to certificates.

In the 1990s and 2000s, source capacity issues had been largely resolved and the system focused on operational upgrades. The most recent two reservoirs were added, and a Supervisory Control and Data Acquisition System (SCADA) was installed to control and coordinate operation at the various sites located throughout the community, and backup power generating capacity was installed at the two most critical sites in the community. Touch read service meters were installed in the late 1990s and were updated to radio read meters between 2010 and 2013. In 2020, a new Badger Beacon Analytics application and meter reading hardware and software were implemented to improve the efficiency of reading service meters and identifying leaks or meter problems.

At this time the community is approaching complete build-out, and additional capacity may be required. System management has been automated from the wellheads to customer meters, sources are redundant and reliable but taxed during peak demands, storage is more than sufficient and backup power is available at multiple sites. Forward planning should focus on maintaining this state and preparing for future replacements as waterlines and other key infrastructure elements age.

The community was platted at a far higher density than permitted under current county zoning, but was completed prior to Mason County comprehensive planning. As a result, lots are “grandfathered”, but cannot be subdivided. Factoring consolidation of lots and building site requirements it is estimated that the water system serving the development will have 1,250 connections at maximum build out. The golf course is irrigated with water pumped from Lake Limerick under separate surface water rights and does not affect water system operations.

1.2.1 Existing Facilities

The system’s source of potable water is entirely from groundwater. The golf course is irrigated using surface water from Lake Limerick. With this irrigation system in place, no potable water is used in the irrigation of the golf course. The irrigation system is not physically connected to the potable water system, and its operation is fully independent of the water system, with its own source, pumps, waterlines, and water rights. It therefore does not factor into the capacity of the potable water supply, except that it reduces demand from the golf course that would otherwise be drawn from the water system. This effect is considered in the capacity analysis in Chapter 3.

Groundwater is withdrawn from 7 wells located on 6 separate sites. The wells were drilled between 1966 and 1988. Most of the sources are completed between 110 and 180 feet, although the latest source (Well 6) was drilled to a depth of over 430 feet. The total pumping capacity of all sources is 944 gpm (complete analysis is available in Chapter 3). Several sources are infrequently used, and one (Well 2) is currently only used for flushing and during firefighting activities.

The water system is comprised of multiple groundwater sources, storage, pressure boosting pumps, and waterlines. Backup power is available at two of the sources and boosting stations, providing multiple redundancies. Control and monitoring are provided by a SCADA system connecting and coordinating the operation of the 6 sites from the water office.

1.3 Related Plans

The following documents were consulted in the preparation of this Water System Plan:

- *Mason County Comprehensive Plan*, updated 2017, and
- *WRIA Watershed Management Plan, Kennedy-Goldsborough Watershed,* Final Draft, February 2006.

Mason County maintains a *Comprehensive Plan* which was last updated in 2017. This document was developed to comply with the State’s Growth Management Act (GMA). The *Comprehensive Plan* provides guidance on which the planning and land use projections within this WSP are based.

Lake Limerick is within the Kennedy-Goldsborough watershed (WRIA 14). In 2006, planning efforts lead by Mason County resulted in a final draft watershed management plan that has not been officially adopted. The draft plan addresses water quality, conservation, and environmental resource issues.

No inconsistencies or objections to the Water System Plan have been identified at the time of writing.

There are no adjacent water systems with which to coordinate in regard to water system planning; the nearest water systems are Rainbow Lake and Emerald Lake which are approximately 0.5 miles south and 1 mile northeast of Lake Limerick's service area boundaries, respectively.

1.4 Service Area, Maps, and Land Use

The Lake Limerick retail service area encompasses an area of approximately 875 acres. A map of the Retail Service Area (RSA) is shown in Figure 1-2. Detailed system maps are included in Appendix 10.1.

1.4.1 Retail Service Area

The retail service area is where a municipal water supplier has a duty to serve connections under the conditions described in Section 1.6. For the Lake Limerick Water System, the retail service area is identical to the existing service area.

1.4.2 Future Service Area

No increase in the system's service area is anticipated; all growth on the water system in the future is expected to be from the infill of empty lots within the existing service area.

1.4.3 Service Area Agreements

The community has never formed any service area agreements with outside utilities. No competing utilities have registered service areas within the bounds of the existing or future service areas proposed by Lake Limerick; therefore, no utility coordination is required.

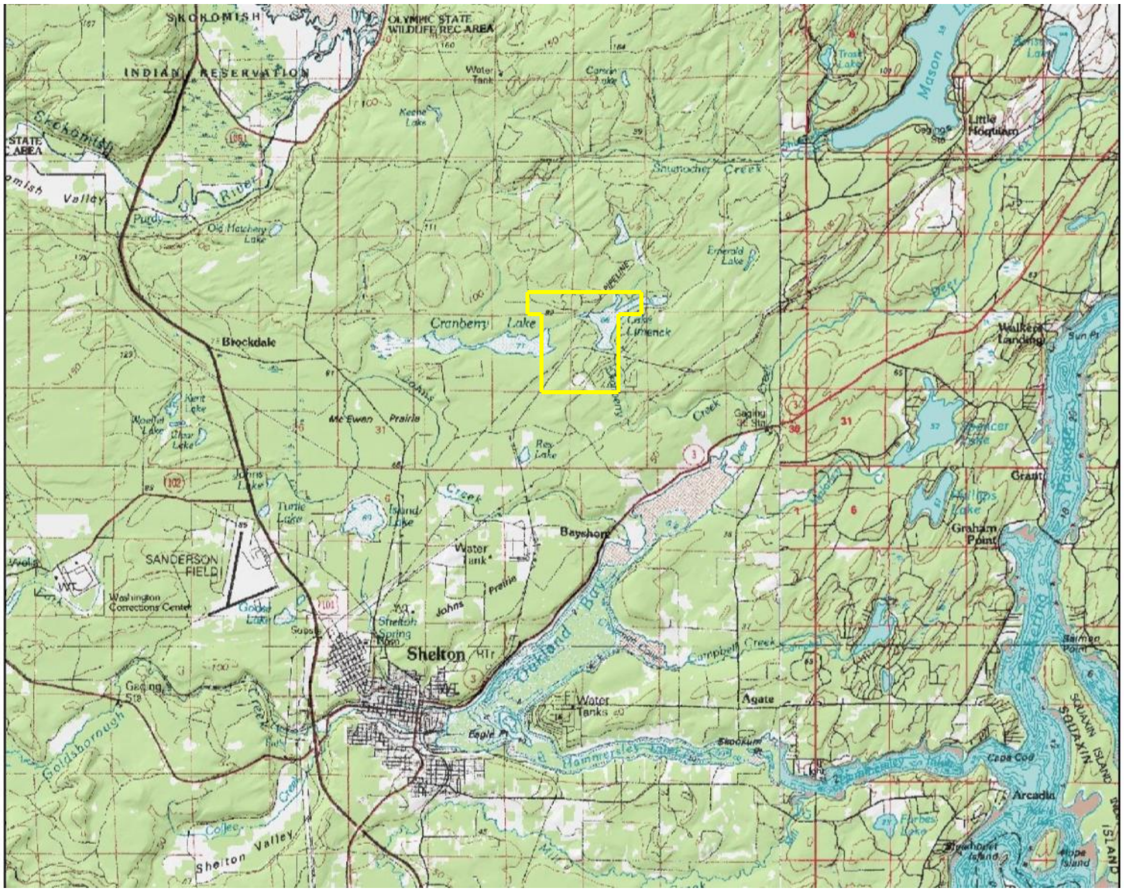

Figure 1-1: Lake Limerick Water System vicinity map.

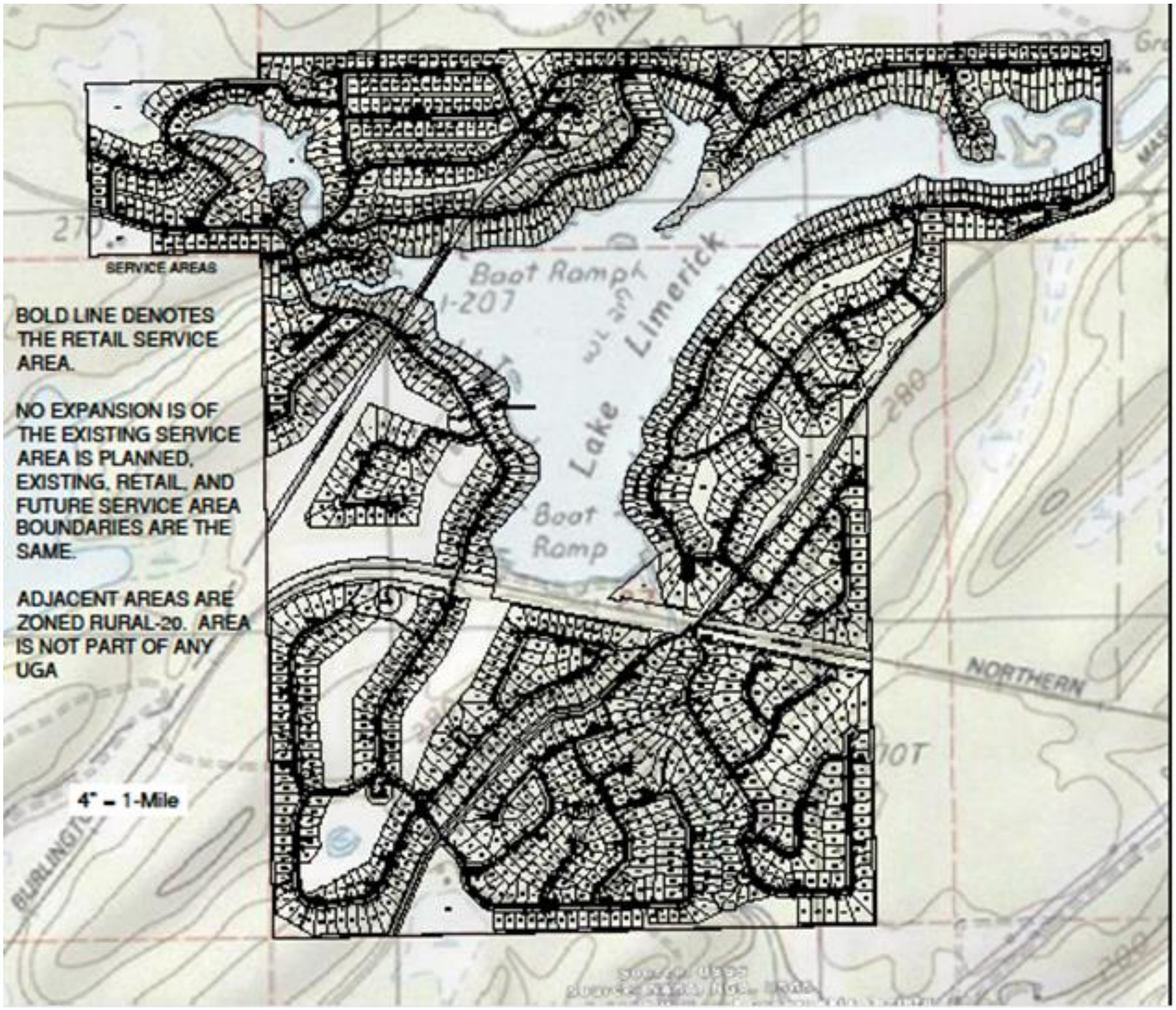

Figure 1-2: Lake Limerick Water System Service Area Boundaries

1.4.4 Land Use and Zoning

Zoning within the Lake Limerick community is shown on maps prepared by Mason County (see maps included in Appendix 10.8). The area is zoned primarily for Rural Residential development with a density of one home per 5 acres. Other zoning designations in the Lake Limerick area include Rural Tourist/Recreational Area (the golf course) and Rural Commercial. Single-family residential land use makes up over 90 percent of the Lake Limerick total land area. One small area of rural commercial development is located at the southern edge of community. Lands identified as Rural Commercial serve neighboring residences with quick shopping or other services compatible with neighboring uses.

1.5 System Policies

The Lake Limerick water system, in its commitment to provide dependable water service in accordance with all applicable regulatory rules and regulations, observes the following general policies.

1.5.1 Annexation

Annexation will not serve as a condition for providing service.

1.5.2 Direct Connection and Satellite/Remote Systems

Future direct connections to the Lake Limerick water system will occur as a result of infill within the retail service area.

Satellite systems are noncontiguous or separate water systems that use separate facilities and infrastructure and may be served by a different source. Lake Limerick does not operate nor has responsibilities associated with any satellite water systems.

1.5.3 Design and Performance Standards

All design and construction shall be completed under the direction of the Lake Limerick Country Club. Standards and details for pipe replacement and new service connection details are included in Section 7.

1.5.4 Outside Customers and Improvement Districts

The system will not serve any outside customers or districts.

1.5.5 Urban Growth Area

The system is not located within an urban growth area.

1.5.6 Late-Comer Agreements

Late-comer agreements do not apply to the system.

1.5.7 Oversizing

The distribution system is capable of serving the entire existing service area. The community has chosen to increase looped lines and dead-end lines over 250 feet in length with larger mainlines whenever they are replaced so that fire flow capabilities can be improved to meet Mason County standards.

1.5.8 Cross-Connection Control Program (CCCP)

Lake Limerick has adopted a cross-connection control policy statement and developed a cross-connection control program and backflow incident response plan (see Appendix 10.12). In accordance with these documents, the installation or maintenance of a cross connection is prohibited. Cross connections that cannot be eliminated shall require the installation of an approved backflow protection device and shall be annually inspected and tested in accordance with the Lake Limerick cross-connection control program.

Services are connected to the watermains in pairs. A misinterpretation of Cross Connection Control regulations led the community to install a single Double Check Valve Assembly (DCVA) on every pair of services at the service lateral. As configured the main distribution lines are fully protected from a backflow incident; however, none of the individual properties were protected from their neighbor. As a result, no one on the system was fully protected from backflow hazards; although the effect of a backflow incident would be greatly limited in scope. The CCCP program has been re-evaluated and redefined to only require installation of DCVAs or other backflow devices on connections identified in hazard surveys conducted every 3 to 5 years.

1.5.9 Extension

No extensions are anticipated nor proposed.

1.6 Duty to Serve

The Lake Limerick water system has a duty to serve all new connections located within its Retail Service Area, so long as the following four threshold factors are met, as described in Washington Administrative Code (WAC) 246-290-106:

1. *Lake Limerick has sufficient capacity to provide water in a safe and reliable manner.*
   Lake Limerick holds a GREEN operating permit with no restrictions on expansion up to the allowed number of connections established by the DOH.

2. *The service request is consistent with state and local regulations.*
   The provision of service within the Retail Service Area is considered to be consistent with the *Mason County Comprehensive Land Use Plan*.

3. *Lake Limerick has sufficient water rights to provide service.*
   The Water Rights Self-Assessment forms included in the Water System Plan (see Appendix 10.9) show that the system has sufficient water rights to meet the water right criteria through build-out.

4. *Lake Limerick can provide service in a timely and reasonable manner.*
   Any applicant requesting water service with the Lake Limerick water system will be required to submit a written request to the Lake Limerick Office. The written request shall include the name and address of the applicant, location of premises where water service is requested, and the purpose for which water is requested. The Lake Limerick Office will respond to service requests with a determination of water availability within 60 days of receipt of the written application.

   For planning purposes, "timely service" is defined as receiving water service within 120 calendar days plus construction time. If the extent of water service requested requires construction of major facilities such as the replacement or installation of new storage tanks, wells, booster pumps or distribution mains, the time associated with construction may be added to the 120 days.

   The provision of new water service is "reasonable" if:

   - The conditions of service are consistent with local land use plans and development regulations.
   - The conditions of service and associated costs are consistent with those documented in the water system plan, and
   - The conditions of service and associated costs are consistent with the water system's standard practice experienced by other applicants requesting similar water service.

1.7 Local Government Consistency

In accordance with the Municipal Water Law, Lake Limerick Country Club is working on obtaining a signed consistency statement from Mason County to document that this WSP is consistent with local area planning. A copy of the Mason County consistency statement will be included in Section 10.17 of the WSP.

1.8 Watershed Plan Consistency

As discussed in Section 1.3 above, Lake Limerick is within the Kennedy-Goldsborough watershed (WRIA 14). The *WRIA 14 Watershed Management Plan, Kennedy-Goldsborough Watershed* was consulted in preparation of this Water System Plan. The watershed management plan addresses water quality, conservation, and environmental resource issues. No inconsistencies between the watershed management plan and this Water System Plan were identified.

Chapter 2 Basic Planning Data

2.1 Current Population, Service Connections, and Equivalent Residential Units (ERUs)

2.1.1 Population and Demographics

The Lake Limerick Community Club is a residential community comprised of full-time residences, seasonal residences, recreational services, and commercial services. The community includes a 9-hole golf course and recreational lake, 7 community parks, 2 restaurants, 1 lounge and a pro-shop for golfing supplies. The breakdown of services as originally calculated in 2020 was as follows:

- 793 Full-time Residences
- 66 Seasonal Residences
- 333 Recreational Service
- 6 Commercial Services

The 2010 census data suggests that the Mason County households in unincorporated areas have on average 2.48 people per household while the 2021 census data indicates there are 2.55 people per household which represents 2.8% increase. Based on this, the 2020 population was estimated to be 1,967 full time residents living in the 793 full time residences. The seasonal residences tend to be occupied by retired couples and individuals. The average Part-Time residential population is therefore estimated based on 2 persons per residence during the summer months, with a peak of 132 residents. The 333 vacation properties see occupancy ranging from a handful to many dozens of persons per day. See the WFI in Appendix 10.7 for monthly transient population estimates. As of July 2020, there were approximately 22 full and part-time non-resident employees of Lake Limerick present throughout the year, and 1 seasonal non-resident employee. As of December 2022, there are 19 full time, 13 part time and 1 seasonal non-resident employees.

2.1.2 ERU Analysis

For the purpose of this report, one ERU is defined as the equivalent usage of a single-family residence occupied full time. The commercial services on average exhibit usage patterns that are reasonably similar to the typical residential use on the system; therefore, they are each counted as a single ERU.

Seasonal residences are counted as a single ERU during the months when they are occupied, and zero ERU for non-occupancy months. The occupancy of the homes begins in April when seasonal residents begin returning from warmer climates, and rises to a peak in July and August, before falling back off. Meter Data sheets show the estimated number of ERU contributed by the seasonal connections varying from 0 to 66 ERU.

Recreational properties are generally owned by people who live nearby and use the property more frequently, and more irregularly than the seasonal population. These properties tend to be used throughout the year, as golfing and fishing amenities are available nearby. Based on meter data, these properties each use an average of 22% of the full-time residences throughout the year. On this basis, the recreational properties account for 0.22 ERU each.

ERU per class was evaluated and characterized for the winter and summer to determine the maximum and minimum ERU on the system. Since seasonal residences cause the total system ERU to vary over the course of the year, summertime system ERU is different than winter. The system's average ERU is used in calculating average day demand, and the peak ERU is used to estimate demand during the summer months.

Table 2-1: ERU Analysis

Class	Services	ERU
Full Time Residences	793	793
Seasonal Residences	66	0 – 66[1]
Recreational Services	333	73
Commercial Services	9	9
Total, Average	1,201	900
Total, Peak	1,201	941

*See footnotes below

2.2 Water Production and Usage

2.2.1 Meter Data

The community has record of production meter data going back over 20 years in one form or another. The community keeps service meter data; however, given the sheer volume of data collected, only the summarizing results are shown. Charts shown in this section were generated using data available in Appendix 10.6. Overall, water use has declined over the past 20 years, as shown in Figure 2-1. However, total usage has increased somewhat from 2013 to 2019 and did not follow the trend projected in the previous WSP. Note that the high use in 2019 was due to several substantial leaks that were repaired near the end of 2019. Annual water use has been reduced annually from-2019 levels and is projected to be at or below 2014 levels. Despite annual water usage increasing since 2013, the average and maximum daily demands per ERU have decreased, due to an increase in the number of ERUs and a decrease in maximum daily demand. The implementation of tiered rate structure in 2020 has had a significant impact on reducing total consumption.

Meter data for the past 20 years shows the combined effects of community growth and of water use efficiency and leak detection efforts on the part of the community. The community has grown from approximately 1,016 connections in 1999 to 1,201 in 2020 and 1,224 in 2022, but water use overall has fallen. Meter data in Figure 2-1 shows a 33% reduction in water use from 98 million gallons pumped in 1999 to approximately 66 million gallons from 2014 to 2020 excluding significant leaks in 2019. Total consumption in 2020 was about 72 million gallons pumped and in 2021 was down to 67 million gallons with 2022 projected to be about 62 million gallons. Figure 2-2 shows quarterly consumption data from 2013 to 2019. The third quarter (July – September) has the highest usage, averaging 25 million gallons over the three-month period.

[1] Seasonal Residences are generally unoccupied from November to March, with occupancy increasing April through June to a peak in July and August, and back down through October. The average number of ERU is the weighted average throughout the year

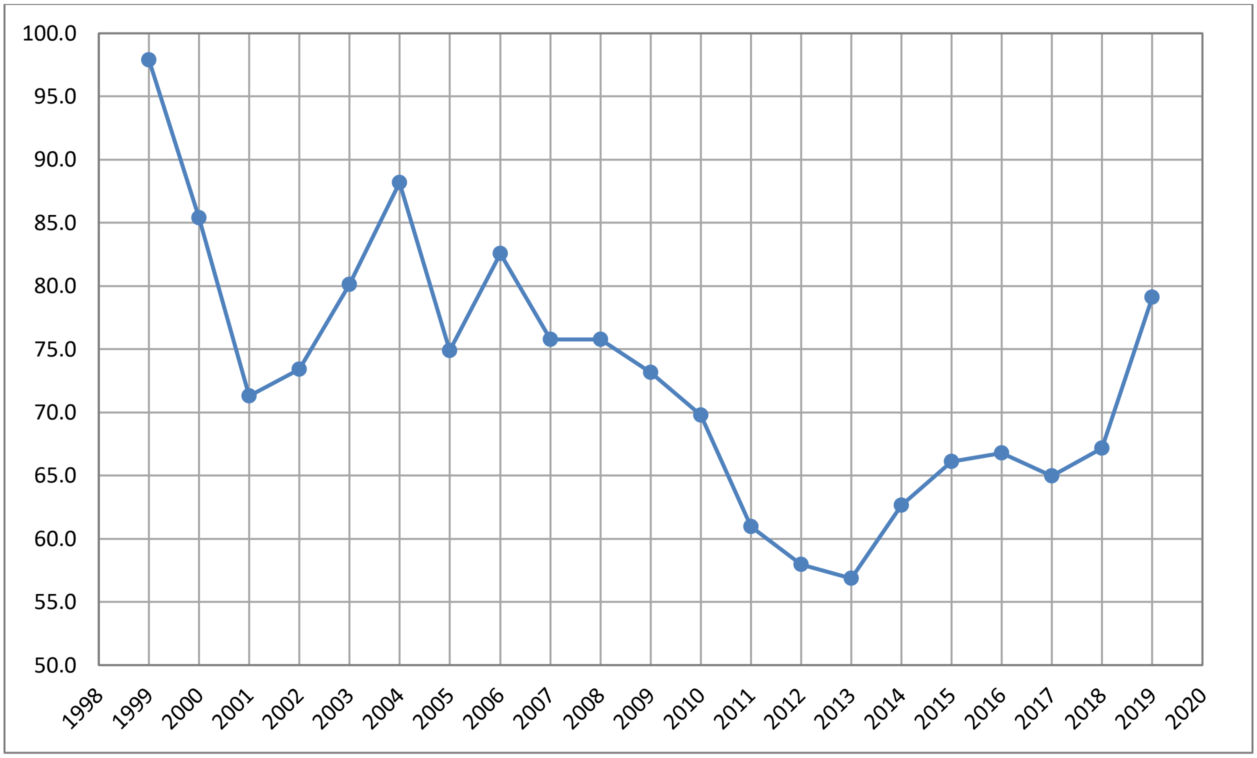

Figure 2-1: Annual Source Production from 1999 to 2019, MGY

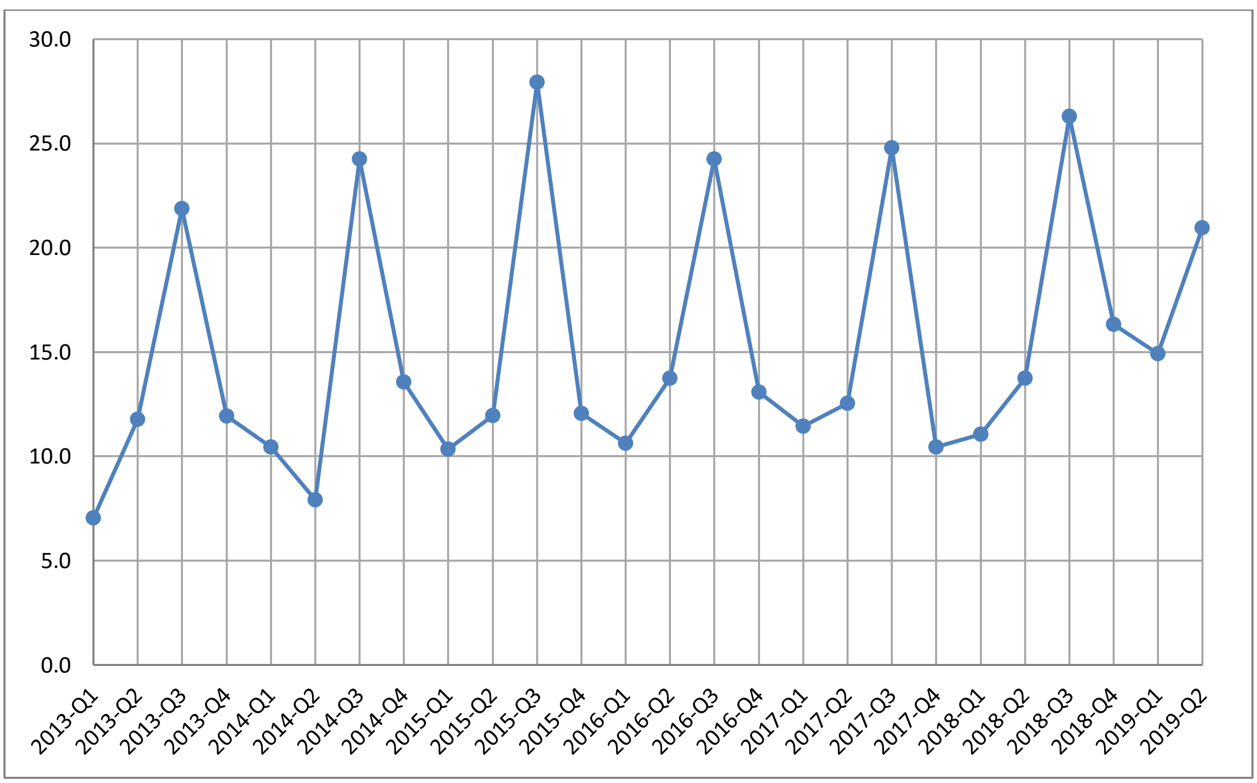

Figure 2-2: Quarterly Consumption in Millions of Gallons

2.2.2 Usage by Customer Class

The system serves the following four classes of customers:

1) Full-time Residential
2) Seasonal Residential
3) Recreational Services
4) Commercial Services

As noted in Section 1.2.1, irrigation of the golf course is fully independent of and separate from the potable water system.

The full-time residential users are the predominant share of connections with 793 connections in 2020, accounting for 66% of the connections, and are the basis for the Equivalent Residential Units (ERU). Seasonal connection usage is essentially indistinguishable from full time residences when occupied, and zero when not occupied. The recreational properties are used for recreational vehicle hookups, water access when camping, and washing boats and other recreational gear. There are six active commercial services, with average annual usage similar to full-time residential connections.

As noted previously, the number of metered connections in the water system have increased from 1201 in 2020 to 1224 in 2022 or an increase of 1.9%, and the population density in Mason County has increased from 2.48 people per household to 2.55 people per household or an increase of 2.8%. Combined this represents a possible increase of 4.8% in ERUs. Contrasting that, the total pumped consumption has decreased from 71 million gallons in 2020 to 67 million gallons in 2021 with a projected amount in 2022 of 61 million gallons resulting in a decrease of between 8% and 14% in total consumption. Taking these factors into account, the following calculations made in 2020 represent conservative values for the various system design parameters.

2.2.3 System Parameters: ADD, MDD, and PHD

The system's metered source production over the past 4 years divided by the system's average ERU yields an average day demand (ADD) of 212 gpd/ERU, which includes distribution system leakage. Over this same period, the maximum daily demand (MDD) was recorded as 488 gpd/ERU. The source meters are read daily which allowed for a direct measurement of MDD. Comparing this measured MDD value of 488 gpd/ERU to the maximum month average demand (MMAD) of 354 gpd/ERU yields a system peaking factor of just under 1.4. This is similar to - and slightly more conservative than - the recommended peaking factor of 1.35 for systems serving greater than 1,000 people. The system's MDD/ERU is significantly lower than reported in the 2012 WSP as a result of a reduction in the maximum daily demand and an increase in the number of ERUs.

When calculating flow rates during fire flow conditions, MDD in terms of gpm/ERU is a useful parameter. This is a simple conversion from days to minutes:

$$MDD = \frac{488\ gal}{day} * \frac{1\ day}{1{,}440\ minutes} = 0.339\ gpm/ERU$$

The peak hourly demand (PHD) may be found with MDD using Equation 3-1 of the WSDM. PHD is calculated for the existing community's peak summertime flow, when 941 ERU of demand is expected.

$$PHD_{exist} = \frac{MDD}{1440}\big((C)(N) + F\big) + 18 = \frac{488}{1440}\big((1.6)(941) + 225\big) + 18 = 604\ gpm$$

Table 2-2: Summary of Current Systems Design Parameters

Existing ERU	900 - 941
ADD/ERU	212 gpd
MDD/ERU	488 gpd
PHD	604 gpm
PHD w/1,250 ERU	802 gpm

Based on the available Water Use Efficiency (WUE) reports, distribution system leakage (DSL) historically has been between 4% and 7% DSL, or about 3 and 5 million gallons per year over the past 10 years.[1] Since there are 525,600 minutes per year, DSL is estimated at between 6 and 10 gpm on average. Since the above calculations are derived from production rather than consumption meter data, DSL is not further evaluated for the purpose of capacity.

2.2.4 Pressure Zones

The system is comprised of a single pressure zone. The elevations in the community range from 210' to 295' based on data obtained from the Puget Sound LIDAR Consortium (PSLC). As a common reference point, the lake is located at 224' of elevation in this data. The system's booster pumps and those wells pumping directly to distribution provide pressure to the system. By matching of the pressure settings of the 6 sites throughout the community, an overall average hydraulic grade line (HGL) of approximately 443' elevation is maintained. Hydraulic analyses at PHD and other conditions are included in Appendix 10.1 showing pressure at various points around the system.

2.3 Distribution System Leakage

Lake Limerick tracks monthly source and service meter data and compares them to determine leakage. The system has exhibited average Distribution System Leakage (DSL) of 10.6% during the three years from 2017 to 2019 due to several significant leaks in 2019. However, looking back over the past ten years, the historical leakage is substantially less than 10%. From 2010-2018, the average annual leakage was only 5.2%. The leaks in 2019 were repaired and the leakage returned to lower levels of 8.5% during 2020 and 4.3% in 2021. The year-by-year leakage is shown in Table 2-3 below.

[1] This does not include 2019 which saw 22.7% leakage (18 million gallons) due to several large and long-lasting leaks. These leaks have since been repaired and DSL is expected to return to normal levels in 2020.

Table 2-3: Distribution System Leakage and Volume

Year	Pumped	Sold	Lost	Loss (%)	Loss (ERUs)
2010	69,790,309	66,840,300	2,950,009	4.20%	38.1
2011	60,958,882	56,483,665	4,475,217	7.30%	57.8
2012	57,963,886	54,775,298	3,188,588	5.50%	41.2
2013	56,859,553	54,275,297	2,584,256	4.50%	33.4
2014	62,649,611	60,973,228	1,676,383	2.70%	21.7
2015	66,109,416	61,749,171	4,360,245	6.60%	56.3
2016	66,784,811	62,157,037	4,627,774	6.90%	59.8
2017	64,963,044	62,010,322	2,952,722	4.50%	38.2
2018	67,149,235	64,162,480	2,986,755	4.40%	38.6
2019	79,119,500	61,189,708	17,929,792	22.70%	231.7
2020	71,162,988	65,090,958	6,072,030	8.53%	78.5
2021	66,707,700	63,814,600	2,893,100	4.34%	37.4
2022	61,300,000	58,240,442	3,059,558	4.99%	39.5
Average (2020-22)	**66,390,229**	**62,382,000**	**4,008,229**	**6.04%**	**51.8**
Average (2010-22)	**65,501,457**	**60,904,808**	**4,596,648**	**7.02%**	**59.4**

Converting the gallons lost per year into a more familiar unit of gallons per minute, we find that the average leak rate for Lake Limerick during a typical year is 6.3 gpm, but averaged 15.1 gpm over the three years from 2017to 2019. The previous WSP compared the Lake Limerick leak rate to the permissible leak rate as recommended by the AWWA Manual for Pipeline Install Practices, M-23 document. However, this is not an accurate metric for comparison. The manual that was previously referenced is intended to provide guidance on new installation of PVC (polyvinyl chloride) pipeline. The Lake Limerick distribution system is primarily composed of asbestos cement pipe installed in the late 1960's making it neither new nor mostly PVC.

Instead of comparing to the AWWA document, the leakage should be evaluated based on the DOH Water System Design Manual and WAC 246-290-820. Using these standards, municipal water suppliers with distribution system leakage of ten percent or less for the last three-year average are considered in compliance. Lake Limerick's leakage has historically been well below this threshold, which is evidence of the effectiveness of the system's commitment to addressing leaks. The major leaks in 2019 bumped the leak rate above 10% for the three-year average from 2017 to 2019, and caused the running three-year average for the next two years to be higher as well. However, the substantial leaks were repaired and the system continues their successful leak detection and repair program which resulted in the annual leak rate returning to below the 5% mark for 2021 and 2022.

2.4 Water Supply Characteristics

The Lake Limerick water system is supplied from 7 groundwater wells, drilled between 1966 and 1988. These wells are geographically dispersed and draw from 2 distinct aquifers. This provides a great deal of reliability and redundancy. Most of the wells have been in continuous use for the past 3-4 decades and there have not been any problems with availability of water from the sources. Additionally, water use efficiency measures over the past 20 years have resulted in lower overall water use, and therefore lower demand on the sources of supply. The system intends to install water level sensors in each of the wells and integrate them with the SCADA system so that the aquifer levels may be monitored and tracked over time to identify seasonal and long-term trends.

2.5 Water Supply Reliability Evaluation

The Lake Limerick community enjoys a high level of reliability. The community is served water from 7 geographically disperse sources drawing from 2 distinct aquifers. These sources have a combined capacity that is sufficient to serve PHD at build-out for the entire community without any reservoir storage. In addition to this the community has 206,086 gallons of reservoir capacity allocated for equalizing storage. The community has backup power installed at redundant sites to provide service to the entire community during sustained power outages. Well site #3 in particular has sources drilled into distinct aquifers and backup power. With these factors, it is important to realize that it would take an extraordinary confluence of events or major regional disaster to disrupt water service to the Lake Limerick water system.

2.5.1 Interties

No interties with other systems exist or are proposed for the Lake Limerick Water System.

2.6 Future Population Projections and Land Use

The community was originally developed with 1,397 lots and the golf course. In 2020 1,201 services were active and in 2022 there are 1224 services The system's 2012 Water System Plan projected service connection counts through 2033, and projected that 1,220 services would be active in 2020. The old Water System Plan anticipated a build-out capacity of approximately 1,250 services. There have been no significant changes to the community or plans in the intervening years, and the projection for maximum build-out is still expected to be correct. However, growth of new connections has been larger than previously estimated. Many of the new full-time connections have been conversions from existing seasonal or part-time connections. Using data available in 2020, an updated 20-year projection is shown in Figure 2-3.

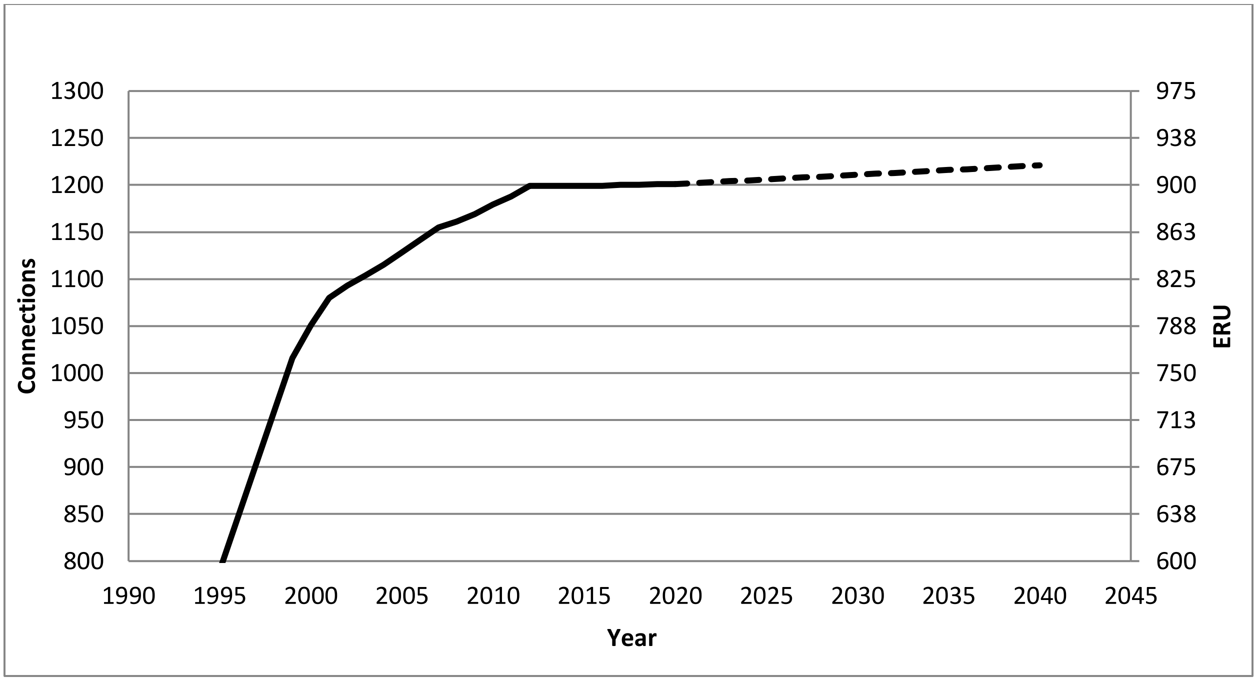

Figure 2-3: Historic and Projected Connections and ERU

The nearby golf course, lake amenities, and character of the area are likely to continue to attract retired and part time residents well into the future. For that reason, it is likely that there will continue to be some number of part-time connections for the foreseeable future. However, the general trend in recent years is toward an increasing ratio of full-time to part-time connections, leading to a gradual increase in the number of ERU's. It is critical to acknowledge that the system must plan for peak demands based on the busy summer-time occupancy.

At the time of writing of the next water system plan update, it will be useful to evaluate in more detail the number of full-time and part-time residents to determine what changes there are in demographics over time. The system has historically grown rapidly enough for increased connections to overcome changes in the relative number of full time and part time homes. However, during this most recent planning period, the majority of growth has been in changes from part-time to full-time connections, while the total number of active services has increased by about 2%. As the 1,250-connection projected build-out is approached, changes in water use will likely become even more closely tied to changes in the full-time/part-time ratio.

2.6.1 Land Use and Zoning

The community was platted for relatively high density rural residential homes, and the golf course. The community is approaching completion of this plan with over 95% of the likely lots already connected. The land use and zoning for the community are therefore not expected to change over the next 10 to 20 years.

2.7 Future Water Demand

The community has a tiered water rate and has maintained a fairly consistent leakage rate for the past decade, save for 2019 when several substantial leaks all occurred in the same year. The community is comprised of largely modern homes with low flow indoor plumbing. It is therefore likely that future conservation efforts will yield less impressive results than seen previously. The figure below shows the projected water demand both with no improvement in conservation and with a maximum 4% reduction in per/ERU water usage over the next 20 years. It is not likely that the community will be able to exceed this level of conservation.

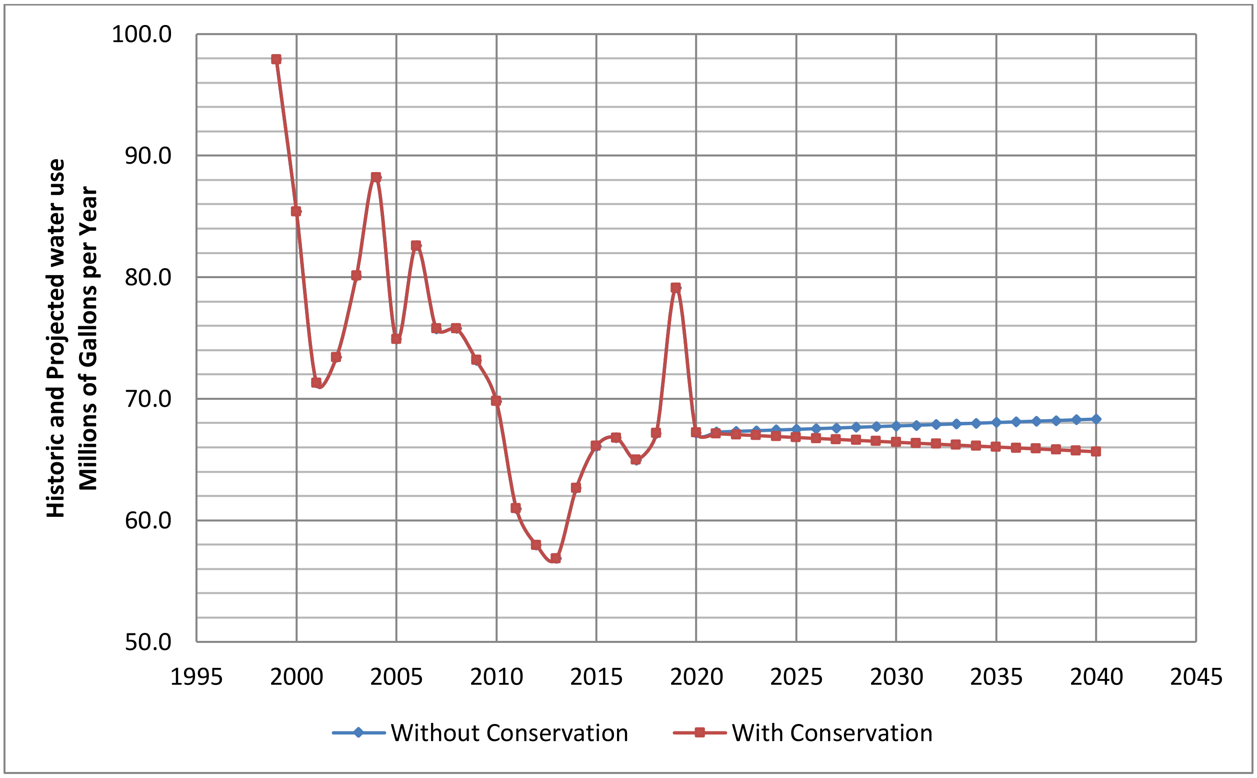

Figure 2-4: Historic and Projected Water Use

2.7.1 Other Systems

No interties exist or are planned to the Lake Limerick water system within the next 20 years. No water use by other systems is therefore considered.

Chapter 3 System Inventory and Analysis

3.1 System Design Standards

All design and future construction shall be completed in accordance with the Washington State Department of Health Water System Design Manual (Design Manual). The following is a brief summary of relevant standards set forth in the Design Manual:

Water Demand	Chapter	3
PHD	Equation	3-1
Capacity Analysis	Chapter	4
Distribution System	Chapter	6
Hydraulic Analysis	Section	6.1

Over the next 20 years the system does not anticipate growing beyond its existing service area. There are various sizes and types of waterlines in service today. The distribution and pumping systems provide sufficient capacity to meet current residential peak demands for the community; however, they do not meet fire flow requirements at all fire hydrants. Two of the system's six sites (Site 3 and 6) have automatic backup power installed on site to provide service in the event of power failure. Either of these sites is capable of providing limited daily demand. There is also a backup generator at Site 2, but it is too old to be maintained and is being decommissioned. A new backup generator at is proposed at an additional well site.

3.2 System Inventory and Asset Condition Assessment

3.2.1 Overview

The community is served water by infrastructure located at 6 sites and the distribution system. Four of these sites include a reservoir and booster station, while two sites consist of wells inside small buildings. All of the sites are tied to the main Water office via the SCADA system. Each of the sites contain one well, except for site 3 which incorporates wells 3A and 3B. The sites without reservoirs pump directly to distribution. All of the sites are monitored and controlled by Remote Telemetry Units (RTUs) which are essentially Programmable Logic Controllers (PLCs) with communications hardware. These RTUs communicate with a central PLC and Master Telemetry Unit (MTU) from which the entire system may be monitored and controlled. All the sites use unlicensed 900-mhz serial modem. Table 3-1 lists the sites and associated hardware.

Table 3-1: Summary of Sites

Well Site	Well(s)	DOH Source Number	Booster Pumps	Backup Power	Reservoir
1	Well 1	SO5	Booster 1	None	Tank 1: 84,600 Gallons
2	Well 2	SO2	None	None	None
3	3A and 3B	SO3 and S06	3A and 3B	Gen. 3	Tank 3: 158,600 Gallons
4	Well 4	SO4	Booster 4	None[1]	Tank 4: 77,000 Gallons
5	Well 5	SO7	None	None	None
6	Well 6	SO8	6A and 6B	Gen. 6	Tank 6: 158,600 Gallons

The community's distribution system consists of an array of 2", 4", 6" and 8" waterline. Arterial waterlines are looped throughout the community, including a complete loop around the lake and several subsidiary loops along with a number of dead-end mains. A summary of pipe sizes and quantities in service are shown in Table 3-2.

Table 3-2: Pipe Inventory

Nominal Pipe Size	Installed Length
2"	2,006 feet
4"	52,310 feet
6"	20,041 feet
8"	973 feet
Total	**75,330 feet**

The community's sources and services are all metered. The service meters are all radio-read capable to allow drive-by meter reading and can provide hourly logs for the month if a customer desires detailed logs. Additional hardware and software improvements in 2020 consisted of Badger Beacon Analytics software and a Dell rugged laptop mounted in the pickup truck for performing meter reads. These upgrades make additional information available in the management reports and allow meters with potential customer-side leaks to be identified readily during meter reading. The service meters are read and billed monthly.

3.2.2 Sources

Lake Limerick has seven wells located at six sites. The pump curves and well logs are given for each site in Appendix 10.3. A summary of the wells is shown in Table 3-3.

Table 3-3: Summary of Sources

Well	Elevation	Well Depth	Static Water Level[2]	Capacity (gpm)	Pumps To	Controlled By
1	275	116	62.0	49	Tank 1	Water Level
2	240	121	14.5	200	Distribution	Pressure
3A	300	148	62.0	144	Tank 3	Water Level
3B	300	177	64.8	194	Tank 3	Water Level
4	270	111	55.2	74	Tank 4	Water Level
5	275	130	38.0	35	Distribution	Pressure
6	270	434	218.3	248	Tank 6	Water Level

The combined source capacity for the system was approximately 944 gpm in 2020. Well 6 is the highest capacity well on the system with an original instantaneous capacity of 248 gpm however current capacity is reduced due to slower aquifer recharge timesIn the absence of this well the system is still able to produce 696 gpm. Well 2 is only used for routine flushing, maintenance and emergency capacity.

[2] Static water level measurements last made November 2018

3.2.3 Water Rights and Capacity

Table 3-4 summarizes the system's water rights and pumping capacities. The water rights self-assessment tables and copies of the water right certificates can be found in Appendix 10.9. The system is within their water rights based on annual usage, and based on water use projections, it is expected that the water rights are sufficient throughout buildout. Unfortunately, the instantaneous withdrawals do not match the well capacities, with some wells having substantially more capacity than the associated water right and others significantly less. During the preparation of the 2013 WSP, a preliminary investigation was performed to determine what it would take to consolidate the water rights across all the wells. At the time, the water system determined that they could continue to manage the individual water rights of the 6 well sites but would consider pursuing consolidating water rights in order to simplify well site management and control.

Table 3-4: Water Rights and Pumping Capacities

Well	Certificate Number	Priority Date	Qi[3] (gpm)	Qa[4] (acft/yr)	Current Capacity (gpm)
1	5566	4/19/1966	100	117	49
2	5887	6/30/1967	200	166	200[5]
3A / 3B	5888	6/30/1967	100	84	338
4	7012	11/19/1968	100	79	74
5	2-27215C	11/17/1987	190	152[6]	35
6	G2-27443C	10/26/1988	200	160[8]	248
Total			890	446	944

3.2.4 Storage

The system's four reservoirs are summarized in Table 3-5. There are 3 concrete round tanks at well sites #3, #4 and #6 and 1 round steel tank at well #1. Reservoir fill elevations governing the operational storage may be adjusted by the SCADA control interface located in the main water office. Reservoir fill levels are stopped several feet below the overflow elevation, effectively making that storage inaccessible. Water cannot be withdrawn below the 6" mud-ring level, leaving approximately 4' of dead storage volume in each of the reservoirs.

Table 3-5: Storage Summary

Tank Name	Dimensions (Feet)		Volumes (Gallons)				
	Height	Diameter	Volume	Gallons per Foot	Operational Storage	Inaccessible and Dead Storage	Remaining Volume
Tank 1	24	25	84,600	3,525	17,625	14,100	52,875
Tank 3	30	30	158,600	5,287	29,079	21,148	108,374
Tank 4	30	21	77,000	2,567	10,268	10,268	56,464

[3] Qi is defined as the maximum instantaneous withdrawal rate allowed by water rights.
[4] Qa is defined as the maximum annual withdrawal allowed by water rights
[5] Well 2 is not used for day-to-day operations.
[6] The annual water rights for Wells 5 and 6 are supplemental to previous water rights and therefore not included in the total annual water rights.

Tank 6	30	30	158,600	5,287	29,079	21,148	108,374
Total			**478,800**		**86,050**	**66,664**	**326,086**

3.2.5 Booster Pumps

Lake Limerick has six booster pumps. Sites 1 and 4 each have one booster pump, while Sites 3 and 6 each have two. The booster pump curves are provided in Appendix 10.4. Booster pumps at sites 1, 3, 4 and 6 are controlled by pressure settings in the distribution system at the respective sites. These pressure settings may be adjusted remotely as necessary from the water office. The system booster pumps are configured to maintain an HGL of approximately 443'. These elevations are measured with a sea level datum, from which the water surface elevation for Lake Limerick is 224'.

Table 3-6: Booster Pump Summary

Booster Pump	Capacity (gpm)	Backup Power Source
1	130	No
3A	210	Generator 3
3B	210	Generator 3
4	150	No[7]
6A	200	Generator 6
6B	200	Generator 6
Total	**1,100**	**Partial**

The system retains 820 gpm of booster pump capacity during a power outage, and 400 gpm if either of the generator stations fails to operate when called on. Both generators are protected from the weather, and one generator is housed in a heated building. Generator 3 is plumbed into utility natural gas giving it an indefinite potential operating capacity. Generator 6 has a 250-gallon propane fuel tank that is topped off when the level approaches 50%. Both generators automatically exercise for a set period each month. Given this maintenance regimen it is extremely unlikely that simultaneous generator and power failures will occur.

3.2.6 Buildings

Most of the Lake Limerick Water System's wells and all of the booster pumps and controls are located within buildings. These buildings are summarized in Table 3-7.

Table 3-7: Summary of Buildings

Site	Building Size	Year Constructed	Notes
1	12' x 9'	1969	
2	9.5' x 20'	1967	
3	9.5' x 9'	1967	Well + Controls
3	6.5' x 9'	1967	Booster Pumps

[7] As noted previously, a new backup generator at Site 4 is being considered. This would add 150 gpm of booster pump capacity.

4	8' x 18.5'	1968	
5	9.5' x 11.5'	1968	
6	17.4' x 26'	2004	Generator Inside

Several roofs have been replaced within the last 5 – 10 years; in general, the building's roofs appear to be functional for another 10 years. The smaller building for Well 3 is in need of significant repair as the walls have deteriorated.

3.3 Capacity Analysis

Service Area

The system does not intend to expand its service area. All growth is anticipated to come from infill within the existing service area. The original plat provisioned 1,397 lots, although combinations and combined ownership will likely prevent the system from ever reaching this number of services. The previous two water system plans projected a maximum build-out of 1,250 lots, because many of the lots are unfavorable to site development, while others have been combined. Since there have been no significant changes in site development requirements, this maximum build-out projection is still considered valid.

$$N_{service\ area} = 1{,}250\ ERU$$

Water Rights

The system's water right is limited to 890 gpm and 446 acre-feet per year (See Appendix 10.9). Reservoir storage could be increased to serve as many ERU as the instantaneous water right permits be pumped at MDD. Therefore, the number of ERU's that may be served by the system's permitted withdrawal under MDD conditions are considered.

$$N_{wr,instant} = \frac{890\,\frac{gal}{min} * 1{,}440\,\frac{min}{day}}{488\,\frac{gpd}{ERU}} = 2{,}626\ ERU$$

From Table 2-2 ADD is 212 gpd/ERU, or multiplying by 365 days per year and converting to acre-feet, a typical ERU uses 0.237 acre-feet per year. Therefore, annual water rights limit the system as follows:

$$N_{wr,annual} = \frac{446\ acft/yr}{0.237\ acft/yr} = 1{,}878\ ERU$$

Source Capacity

Reservoir storage can be used to increase the capacity of the system to serve instantaneous demand of the system. The sources must still provide sufficient capacity for the maximum daily demands. Peak daily production is found by taking the product of the instantaneous capacity for each well, the number of minutes in the day, and the percentage of the day that the wells may be operated. In general wells should not be pumped for more than 50% of the day at their peak capacity year-round; however, on peak demand days they may be pumped up to 20 hours (roughly 83% of the day). Using this ratio, the source capacity from each well is as follows:

Table 3-8: Daily Source Capacities

Well	Pumping Capacity
1	58,800 gpd
2	240,000 gpd
3A	172,800 gpd
3B	232,800 gpd
4	88,800 gpd
5	42,000 gpd
6	297,600 gpd
Total	**1,132,800 gpd**

The source capacity in terms of the number of ERUs that may be served is then calculated using the MDD of 488 gpd/ERU as follows:

$$N_{source} = \frac{1{,}132{,}800\ gal}{488\ gpd/ERU} = 2{,}321\ ERU$$

Pressure Pumps

The booster pumps listed in Section 3.2.5 have a total combined capacity of 1,100 gpm. Both Well 2 and Well 5 directly pump to distribution at pressure and may be added to the total pressure supply capacity. Wells 2 and 5 have 200 and 35 gpm capacity respectively. In all, the system can deliver 1,335 gpm to the distribution system between the two wells and 6 booster pumps. Using the rearranged PHD equation for ERU, the booster pump limits the system to:

$$N_{booster} = \frac{\left(\frac{1{,}440(1{,}335 - 18)}{488} - 225\right)}{1.6} = 2{,}288\ ERU$$

Storage

As noted in Section 3.2.4 the system has storage located at 4 sites totaling 478,800 gallons. Typical set points reduce the available usable volume of the reservoir. Although this could be readily adjusted, it is included since it is the current operating condition. Table 3-5 gives the sum of unusable volumes for the system: 66,664 gallons.

Given the flow rates from each of the well pumps throughout the system (all of which are under 250 gpm), none of the reservoirs should require more than 1,000 gallons of operational storage; however, additional storage is allocated by control settings. To promote additional turnover of water in the reservoirs, the SCADA control settings are configured to draw down as much as 5 feet prior to starting well pumps. The operational storage shown in Table 3-5 was calculated from the typical control settings, which provide operational storage greatly exceeding that required by the WSDM. From this table, 86,050 gallons are allocated to operational storage.

Although full fire flow is not currently provided, based on recent hydrant flow tests and hydraulic analyses by RH2 Engineering (see appendices), limited fire flow could be provided by the Lake Limerick Water System at specific hydrants. Although the pumping system is adequate to provide fire flow. and portions of the water system could support fire flow, a large portion of the distribution system cannot. Notice was provided during the preparation of an early water system plan to the Mason County Fire Marshall specifically instructing them not to use the system for fire flow. When the distribution system has been upgraded and new hydrants installed to support fire flow, current fire code effective in Mason County would require 120,000 gallons of fire suppression storage. The system is not required to maintain this volume at this time because the distribution system is inadequate for full fire flow, but it is provisioned in this analysis to establish its inclusion will not become a limiting factor once fire flow is provided by the distribution system. It is anticipated that the county fire marshal will allow stacking of fire suppression storage and standby storage.

Standby storage is required for community water systems and is intended to provide continued water supply during electrical or mechanical failures, source contamination, etc. Equation 7-2 in the Design Manual provides a starting point for calculating standby volume:

$$SB = (N)(SB_i)(T_d)$$

Where N is the number of ERUs, SB_i is the standby volume in gallons per day per ERU, and T_d is the number of days standby storage will be available. This equation calculates standby volume as 458,697 gallons, the system's MDD.

This volume may then be adjusted based on factors specific to the water system. Since the system has multiple reliability measures, the alternative minimum of 200 gpd per connection may be used. As noted in Section 3.2.5 the system has two independent sites with backup power generation. Each of the backup power systems are well maintained, and two of them include boosting systems capable of delivering ADD flow to the community. The daily capacity of each site to deliver water to (1) the reservoir, and (2) the distribution system are shown in Table 3-9.

Table 3-9: Capacity of sites with standby power

Site	Source Capacity	Notes
Site 3	486,720 gpd	Existing and regularly maintained
Site 4	106,560 gpd	Proposed new generator likely to be here
Site 6	357,120 gpd	Existing and regularly maintained

Both of the sites with existing and maintained generators could provide more than the 200 gpd required per service, and once three sites are operational (Site 3, 6, and 1 site to be determined), PHD might be available by standby power alone. The community has never needed to draw on standby storage. For this reason, no standby storage is provided by the reservoirs.

The only remaining use for the reservoir is equalization storage, providing additional capacity to the system during PHD. WSDM equation 7-1 is solved for PHD, then substituted into equation 3-1 and solved for the number of ERU to determine the limitation imposed by equalizing storage. Table 3-5 indicates a remaining volume of 326,086 gallons after accounting for operational and dead storage. Reserving 120,000 gallons of fire suppression storage leaves a volume of 206,086 gallons available for Equalizing storage. The value used for source capacity, Qs, is the capacity of all sources less Well 2, which is generally not used except for flushing and fire prevention.

$$ES = (PHD - Qs)(150\text{min}) \rightarrow PHD = \frac{206{,}086gal}{150min} + 744gpm = 2{,}117\ gpm$$

Rearranging equation 3-1 of the WSDM to obtain ERU from PHD:

$$PHD = \frac{MDD}{1440}\big((C)(N) + F\big) + 18 \rightarrow N = \frac{\left(\frac{1440(PHD - 18)}{MDD} - F\right)}{C}$$

$$N_{Reservoir} = \frac{\left(\frac{1440(2{,}117\ - 18)}{488} - 225\right)}{1.6} = 3{,}730\ ERU$$

Dead storage, operational storage, and fire suppression storage do not constrain the reservoir's capacity to serve. Standby storage is not provided by the reservoirs, but rather by multiple redundant, geographically dispersed backup power and pumping systems, so it is also not a limiting factor. Therefore, the limiting factor for the reservoir is the ability to provide equalization storage. The reservoirs can serve 3,730 ERU as configured and are therefore more than adequate.

The table below provides a summary of the total storage volume allocation. Note that Fire Suppression Storage is not currently required but is accounted for in the reservoir volume so that it does not impact the limiting factors analysis once the distribution system can support fire flow. Standby volume is not provided by the reservoirs, as discussed above.

Table 3-10: Summary of Reservoir Volume Allocations

Storage Component	Volume (gal)
Dead Storage	66,664
Operational Storage	86,050
Fire Suppression Storage	120,000
Standby Storage (stacked with FSS)	120,000
Equalization Storage	206,086
Total Storage	478,800

Distribution System

Maximum PHD that the current distribution system can support was determined by configuring a base demand at each of the 62 nodes in the hydraulic model, and iteratively increasing flow rates until the worst-case node fell to 30 psi. The flow required to reach this amount of friction loss was found to be 3,968 gpm. Using this in the rearranged Equation 3-1 from the WSDM as used above yields the distribution system limitation.

$$N_{Distribution} = \frac{\left(\frac{1440(3{,}968\ - 18)}{488} - 225\right)}{1.6} = 7{,}144\ ERU$$

Based on RH2 Engineering hydrant tests and hydraulic tests included in the appendices, the system could provide limited fire flow with the existing distribution system.. Based on those tests and analyses, 12 of the system's existing 45 hydrants could provide between 500 and 900 gpm, and the remainder could provide between 250 and 500 gpm.

Summary

The current systems limits are shown in Table 3-11.

Table 3-11: System Capacity Summary

Limitation	Maximum ERU
Service Area	1,250
Water Rights, Instantaneous withdrawal	2,626
Water Rights, Annual withdrawal	1,878
Total Source Production	2,321
Booster Pumps	2,288
Reservoirs	3,730
Distribution System	7,144
Most Limiting Factor: Annual Water Rights[8]	**1,878**

3.3.1 Water Rights Self-Assessment

See completed Water Rights Self-Assessment documents in Appendix 10.9 for existing status and 20-year forecast.

3.3.2 Source of Supply Analysis

The water system is served by 7 groundwater sources tapping into two distinct aquifers. As established in Section 3.2.2, the systems sources have more than adequate capacity to serve the community. Even with the loss of one or more sources, the system would have adequate supply to meet all demands. The system is projected to never require full exertion of its annual permitted water right. There is therefore no reason to expect any applications for additional water capacity to be necessary for the community.

[8] While service area expectations are important, the annual water rights are considered the true limiting factor, as future re-zoning, system expansion, or use of ADU's could potentially increase the number of connections above 1,250.

3.4 Distribution System Analysis

3.4.1 Model Description

The hydraulic model that was developed for the 2012 Water System Plan is no longer available to be used and modified. Rather than re-create the model for new analysis scenarios, the system demand parameters were evaluated to determine whether a new hydraulic analysis would be necessary. It was found that the system MDD and estimated PHD values have decreased since the previous analysis was performed in 2012. Therefore, the results of the original analysis are sufficient (and conservative) for estimating system pressures and line velocities and a new hydraulic analysis is not required. The following narrative explains how the original model and scenarios were developed.

The system hydraulic analysis was prepared using WaterCAD software. The model was comprised of a 69-node system. 62 nodes are distributed to represent the system's lot distribution and are assigned a unit demand. 7 nodes are placed for pipe intersections and given zero demand because of close proximity to other nodes that would have exaggerated the demand for a given region. System records were examined to determine the appropriate pipe size and material for the model. Google Earth, PLSC, and system pressure measurements were reconciled to provide the most accurate elevation model feasible. The node map, pipe inventory, and model results for the various scenarios evaluated are included in Appendix 10.1.

Pump stations are modeled as reservoirs with a set free surface elevation designed to model the set points for the booster stations, the points with the highest hydraulic grade. The system elevations and pressure measurements show that the system maintains an HGL of 443' under normal operations using Puget PSLC and Google Earth data. For comparison to previous hydraulic analysis of the system, this dataset gives a mean water surface of Lake Limerick at 224'. The HGL was selected to match the set point pressures on the system. The booster pump capacities listed in Section 3.2.5 are evaluated assuming water service is provided at this pressure. There is one pressure zone in the water system.

3.4.2 Scenarios

The LLCC Water System is not required to provide fire flow; therefore, only the capacity to serve PHD and Static conditions were evaluated. Demand was assigned by multiplying the unit demand at the node by a demand adjustment factor. For PHD this model was run using 2012 conditions (817 ERU), the original 20-year projection (845 ERU), and for complete build-out with full occupancy (1,250 ERU). The static condition was evaluated by setting the demand adjustment factor to zero, which gives zero system demand and maximum pressures.

The community may plan to establish a baseline fire suppression capability in the near future without upgrading waterlines based on results of testing and hydraulic engineering modeling. The community does not plan on replacing significant portions of waterlines within the 10-year planning period. The community has chosen to increase looped lines and dead-end lines over 250 feet in length with larger mainlines whenever they are replaced. This is being done so that the system will eventually meet fire flow standards. A scenario was prepared that showed that this level of upgrade will be sufficient to meet fire flow requirements.

3.4.3 Model Results

Model results show that the system exhibits minor friction losses, with pressure differences largely driven by elevation. The system will be able to deliver water to every point in the system at PHD with just 4.5 feet of head loss due to friction to the worst-case locations (both located at extreme ends of long lines). Excluding waterlines from the booster stations to the distribution system, the maximum velocity at PHD will be 1.49 ft/s throughout the water system. The current projection for minimum system pressure throughout the system at build-out PHD is 57.5 psi, and the maximum is 101.2 psi.

Table 3-12: Summary of Distribution Model Results

	2012 Model Results				Current (2020) Projections		
Parameter	2013	2019	2033	Build Out	2020	2040	Build Out
ERU	817	830	852	1,250	941	957	1,250
PHD (gpm)	792	794	815	1,142	604	614	802
PHD Low Pressure (psi)	57.5	57.5	57.5	57.4	57.5	57.5	57.5
High Pressure (psi)	101.2	101.2	101.2	101.2	101.2	101.2	101.2
Peak Line Velocity (ft/s)	1.46	1.46	1.51	2.10	1.12	1.13	1.49

Static conditions were evaluated assuming maximum pressure set points for booster pumps are reached. This occurs at 444 feet HGL, giving a peak distribution pressure of 101.2 psi along East Olde Lyme Road as it follows a small valley at the south east of the lake. Public water systems typically maintain pressures below 80 psi; however, the system has operated in this manner for over a decade without experiencing problems or complaints from customers. No operational changes are proposed to change the peak pressures in Division 5. However, pressure reducing valves have been installed at customer residences where the measured pressure is higher than normal limits.

3.5 Summary of System Deficiencies

The system has possible hydraulic capacity limitations which are being addressed. Although modeling suggests that the system will be able to provide adequate flow and pressure through any likely level of community build out and occupancy, there are concerns that will be evaluated. The distribution system does not currently provide fire flow at all hydrants, but this is not considered a deficiency because it is not required, due to the system being grandfathered in under the old regulations. However, upgrading the distribution system to support fire flow is listed as an improvement item as the community plans to increase mainline sizing when it is replaced so that fire flow may eventually be provided. The community plans to establish a baseline fire suppresion capability in the near future without upgrading waterlines based on results of testing and hydraulic engineering modeling

The previous WSP update, prepared in 2012, recommended one other significant improvement, which was to address the miss-matching of water rights to the sites. Annual water production is, and is projected to remain, significantly lower than the annual water right available; however, the instantaneous permitted flows at several of the sites significantly exceeds the installed pump capacity, while at other sites the installed capacity exceeds the legally permitted right. These discrepancies can be clearly seen in Table 3-4.

An ideal water rights change would permit the same overall instantaneous use of 890 gpm, but would permit the water to be withdrawn more flexibly from any combination of sites. This would allow the system to use its SCADA control software to limit the overall output of the wells to match the permitted water right. As configured, there is no way to accomplish this, as several of the wells simply pump at greater instantaneous rates than permitted. Note that overall production, and thereby impact on the region aquifers, would not be changed as a result of the change application. The key change this would have would be to make it possible to use the SCADA control system to meet legal appropriation limits.

The process to consolidate the water rights would require hydrogeological testing and potentially a cost reimbursement agreement. Because overall water use is substantially lower than the total allowed under the existing water rights, the system can continue to operate with the water rights as-is. However, the water system may reevaluate this in the future if the management and control of the well sites becomes too complicated to stay within the water rights.

Chapter 4 Water Use Efficiency Program

In 2003, the Washington State Legislature passed Engrossed Second Substitute House Bill 1338, known as the Municipal Water Law, to address increasing demand on the state's water resources. The law established that all municipal water suppliers must use water more efficiently in exchange for water right certainty and flexibility to help them meet future demand. The Legislature directed the Department of Health to oversee and enforce a WUE program to help support the collective goal of ensuring a safe and reliable drinking water supply. The WUE program seeks to support this goal in the following ways:

- Contribute to long-term water supply reliability and public health protection,
- Promote good stewardship of the state's water resources, and
- Ensure efficient operation and management of water systems.

This program became effective on January 22, 2007 and established certain responsibilities that water suppliers must fulfill. Fundamental elements include the following:

- Water use efficiency program,
- Distribution leakage standard,
- Goal-setting and performance reporting, and
- Metering requirements

The requirements and deadlines are listed below and in order of due date for Group A municipal water suppliers.

Table 4-1: Summary of WUE Program Requirements

Requirement	Deadline for MWS with 1,000 or more connections
Include WUE program in planning documents	January 22, 2008
Submit first annual WUE report	July 1, 2008
Submit service meter installation schedule	July 1, 2008
Set your own WUE goals	July 1, 2009
Meet distribution leakage standard (based on 3-year rolling average)	July 1, 2010, or 3 years after installing all service meters
Complete installation of all service meters	January 22, 2017

This chapter summarizes Lake Limerick's compliance with conservation planning requirements including the actions taken to promote water use efficiency, and the conservation program that Lake Limerick will implement. The applicable WUE program requirements and guidelines are contained in *Water Use Efficiency Guidebook*, Third Edition, January 2017 (DOH 331-375).

4.1 Source and Service Metering

4.1.1 Source Meters

All sources are metered. Any additional sources developed in the future will be metered when installed.

4.1.2 Service Meters

The system is fully metered. Lake Limerick replaced "touch read" service meters with "radio read" meters between 2010 and 2013. The new meters are read and billed monthly. The system billing software provides month by month total usage reports which are used for calculating distribution system leakage. The individual meters record data on an hourly basis, permitting the detection of leaks on private residences as well.

4.2 Distribution System Leakage

If a system's distribution system leakage exceeds 10 percent, the conservation program must also provide an implementation program that includes leak detection and repair, and other measures to reduce water loss. Lake Limerick's distribution system leakage has averaged 5.2% over the past decade but was 22.7% in 2019 due to several large leaks. These leaks were repaired however additional leaks occurred and were repaired in 2020 with the leakage down to about 8.5%. Annual leakage returned to more normal levels of 4.3% in 2021 and are on track to be around 5% to 6% for 2022.

Lake Limerick maintains this low level of leakage with a continuous leak detection program. Staff have training and equipment to respond to leak reports from customers generally within a few hours of the report. In March 2020, the water system implemented a new Badger Beacon meter reading program that flags customer leaks if there is a constant minimum flow 24 hours a day. Initial customer leak reports indicated there were over 100 customer side leaks. The total number of meters showing leaks is now less than 100. Significant discrepancies between service meter and source meter records are investigated. To improve customer side efficiency, the system operator notifies customers of possible leaks and assists with on-site leak detection and education for customers. The effectiveness of these efforts is shown in the community's historically low rate of DSL.

4.3 Water Use Efficiency Program

4.3.1 Current Program

The Lake Limerick board of directors recognizes that water is a valuable commodity, and the wise and efficient use of water is a goal that is in the best interests of its customers.

4.3.2 Goals

State regulation (WAC 246-290-830) requires the governing body of the municipal water system (the Lake Limerick Board of Directors in this case) to develop the water use efficiency goals through a public process. The previous WUE goal was considered in a public meeting held on November 23, 2011. An updated WUE goal will be considered in a public meeting and added to the WSP after the meeting. The new goal will need to be a measurable goal over the 10-year planning period.

With the implementation of the new Badger Beacon meter reading system, the water system staff has better visibility of customer side leaks. A new goal is to notify customers when the meter reading system identifies a possible leak and to initially reduce the total number of leaks by 5% as measured by the meter reading system. There has already been initial success in reducing customer leaks.

The system had seen significant year-over-year improvements in conservation leading up to the 2012 WSP. Annual water use has since increased somewhat from the 2013 low as a result of adding connections and part-time users becoming full-time users. However, the average daily demand per ERU has actually decreased slightly from 224 gpd/ERU to 212 gpd/ERU. The stated WUE goal as of the last public meeting was to maintain the per-ERU average usage; the community has been successful in meeting and exceeding this goal.

The proposed goal to be achieved during the next 10 years is as follows:

- Within five years, reduce the average per capita daily water usage by 5 gallons.

4.3.3 Measures

As part of a water system plan, DOH regulations also require the implementation of a specified number of water use efficiency measures. With over 1,000 connections (See Table 2-1) Lake Limerick is required to evaluate or implement at least WUE measures. Lake Limerick has implemented the following six water use efficiency measures:

1. A tiered rate structure encourages people to track and reduce their usage.
2. The systems service meters provide hourly data permitting the operator to identify leaks within private residences.
3. Customer leaks are detected by the new meter reading system and customers are notified of significant leaks.
4. Upgraded the water billing software which includes customer water usage history in addition to other benefits.
5. Held Town Hall meetings to educate customers about the Water System operation and encourage fixing leaks and promptly notifying the Water System of water leaks they notice.
6. Install distribution system meters to measure the net flow into the distribution system from each well site. Once these are connected to the SCADA system, they will provide real time flow into the water network.

4.3.4 Reclaimed Water

Systems serving more than 1,000 connections are required to evaluate reclaimed water opportunities. The Lake Limerick system is comprised of properties that have private septic systems, and therefore would not be able to implement a sewer treatment plant for reclaimed water use. However, the golf course is irrigated from the lake under a separate water right (certificate number 10661) rather than from the potable water system, which is a more efficient use of water resources and saves potable water for drinking water purposes.

4.3.5 Consumer Education Program

Lake Limerick is required to provide general education to its customers on the importance of using water efficiently on an annual basis. Water conservation information is included in the annual consumer confidence and water use efficiency reports provided to all Lake Limerick customers in order to meet the annual customer education requirement.

If customer education is provided more than once a year, then conservation education may be counted as one of the required measures. Conservation reminders are regularly included in the Lake Limerick Country Club quarterly newsletter and in the water bills. The Water Committee Chair also presents updates monthly at Lake Limerick Board meetings regarding water system operations, leak detection and water conservation.

4.3.6 Annual Reports

Lake Limerick collects meter data and reports total production, in gallons, from all sources for the year and total authorized consumption, in gallons, from all customers for the year to DOH in their annual Water Use Efficiency Report.

4.3.7 Water Rates

According to WAC 246-290-100(4)(j)(iv)(B) and 246-290-105(4)(l), LLWS is required to evaluate a rate structure that promotes water conservation.

In fiscal year October 2019 to September 2020, the community operated on a simple base-rate plus overage fee structure with a base charge of $30 per month for up to 10,000 gallons, and $2.00 per month for every 1,000 gallons over 10,000 gallons plus reserve payments of $8/full lot. Meters are read and billed on a monthly basis.

A rate study was performed in 2020, which resulted in recommended modifications to the existing rate structure. The primary changes proposed were to move to a fully tiered water rate (as opposed to the existing simple base charge plus excessive use fee) and to adjust the charges such that overall revenue will increase in order to adequately fund long-term reserves for future replacement of the water lines. A new tiered rate structure was implemented in fiscal year October 2020 to September 2021 and has been updated each subsequent year to match budget requirements. This is discussed in more detail in Chapter 9.

4.4 Water Use Efficiency Savings

Most of the water savings has come from an aggressive leak fixing program implemented between 2005 and 2010. During this period, annual water production dropped from over 75 million gallons per year to under 60 million gallons per year. The leak program and replacement of service meters are likely to be the last major efficiency improvements that are possible. Future reductions in consumption are likely to be driven by customer behavior, which is primarily influenced by demographics, rate structures, and customer education programs. Although demographics cannot be directly controlled by the water system, providing customer education and maintaining tiered water rates can both be controlled.

The community has tracked electrical consumption and compared it to production to determine the effectiveness of water delivery. It has found that the system overall delivers typically about 200 to 400 gallons of water per kilowatt hour (kWh) of energy input dependent on the efficiency of the well site. The effectiveness varies significantly between summer and winter as higher heating costs combine with smaller demand to reduce the water delivered per kWh of energy input. As an annual average, the system overall can deliver about 300 to 350 gallons per kWh. Using this delivery effectiveness measure, and the average electrical rate of about 10 cents per kWh, the system can evaluate the cost-benefit of prospective water use efficiency measures. Two useful metrics are that the system saves $1,000 per 3.5 million gallons conserved, or the system can save up to one dollar for every 4 gpd conserved by residential customers. There are other more intricate cost savings associated with reduced demand, such as pump lifespan. However, this is dependent on a number of other factors and operational conditions, which makes the exact impact difficult to calculate. Reduction in electrical usage is straightforward to relate to water use efficiency and provides a ballpark number for cost reduction.

Using this basis, it can be seen that the leak detection and correction project is saving the community about $2,500 per year, a price that is likely to show some benefit over the long term. In order for the $1,500 estimated cost of the current WUE measures to be financially viable, they must result in at least 5.2 million gallons of water savings. In a community using just 212 gpd per home, additional measures are unlikely to yield a significant reduction in water use and would be difficult for the community to justify internally funding. However, state and federal programs are available that may provide funding for additional WUE efforts. The WUE Guidebook (DOH 331-375) lists several of these funding options. It is recommended that the community consider what further WUE measures may be of benefit, such as offering faucet replacement incentives, installing zone metering, etc., and investigate possible grant money to cover the costs of these projects.

Chapter 5 Source Water Protection

5.1 Wellhead Protection

The wellhead protection program has been developed in conjunction with the WSP. The following susceptibility assessment, protection area, and contamination source inventory will provide the necessary documentation to make educated management and land use decisions to prevent aquifer contamination.

5.1.1 Susceptibility Assessment

Ground Water Contamination Susceptibility Assessment forms for each source for the Lake Limerick Water System are included in Appendix 10.10. The results of the assessment are summarized in this Chapter.

5.1.2 Wellhead Protection Area

A map showing the 100-foot protected radii and the 6-month, 1-year, 5-year, and 10-year ground water travel radii is given in Appendix 10.10. The well protection radii are calculated using the formula found in the susceptibility assessment as provided by the WSDOH.

5.1.3 Contamination Source Inventory

The following are potential sources of contamination within the 10-year travel time radii:

1. Residential Septic Systems
2. Residential Chemical Applications (Pesticides, herbicides, etc.)
3. Private and County Roadways
4. Pesticide and Herbicide application on golf course fairways

Since land use and zoning throughout the service area is unlikely to change, changes in, or addition of, sources of contamination are unlikely.

5.1.4 Notification of Findings

The following agencies will be provided with a letter (see Appendix 10.10 for a copy of the notification letter) requesting information about any potential sources of contamination within the Wellhead Protection Radii:

Mason County Health Department
Mason County Department of Community Development
Emergency Services (911)

All the homeowners with lots within the 10-year radii will also be sent a notification letter. See Appendix 10.10 for copies of the notification letters.

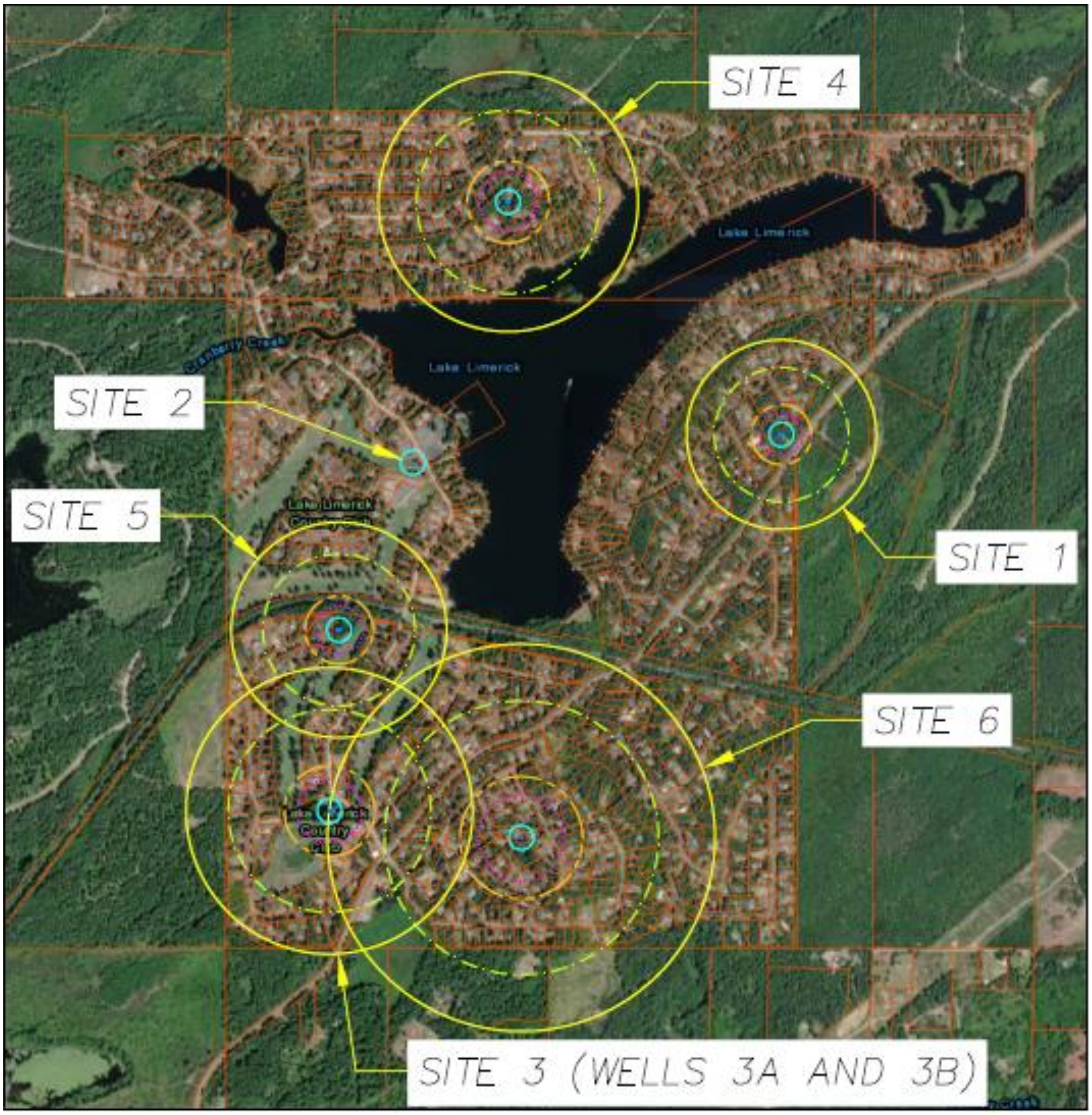

Figure 5-1: Wellhead Protection Areas

5.1.5 Contingency Planning

The community has sufficient source redundancy to lose several groundwater sources to contamination and maintain service. In the event of contamination, the source would be taken offline while the source of contamination was located and corrected. Since the sources are approximately a quarter of one mile from each other, it is unlikely that anything short of intentional contamination would affect more than one source at once.

In the extraordinarily unlikely event that both aquifers were completely contaminated and groundwater was inaccessible to the community, boil water notification and lake water could be used on a short-term, interim basis while emergency responders take action. The possibility of this action being required is extremely remote.

5.2 Water Quality Analysis

5.2.1 Asbestos

Asbestos levels in the water system's samples were below the state reporting limit in the most recent round of sampling, which was performed in November of 2018.

5.2.2 Bacteriological Testing

The system tests two samples from the distribution system for coliform bacteria each month. In the past 5 years there have been 7 coliform violations. These were in samples taken September 20th, 2018, October 17th and 21st, 2019, and January 14th and 20th, 2020. The system has historically been sampled from hose-bibs throughout the community, which are prone to producing false positives. The system is currently in the process of installing dedicated sample stations to reduce the false-positive detection rate. The Coliform Monitoring Plan is included in Appendix 10.11.

5.2.3 Inorganic Chemicals (IOC)

IOC samples have been taken from each source on the system over the past 5 years. No EPA-regulated primary contaminant has exceeded the states Maximum Contaminant Level (MCL). Only Well 2 has exceeded any MCL, with Iron levels of 0.6 mg/L and Manganese levels of 0.066 mg/L. Well 2 is not used in day-to-day operations, and has pressure set points that prevent it from starting unless auxiliary capacity is required. Therefore, no treatment is proposed for the well.

5.2.4 Lead and Copper

The system performs routine lead and copper sampling every 3 years from the distribution system. Lead and copper have been present in the samples above the minimum detection limits; however, none have exceeded the action level of the Lead/Copper rule so no treatment is required. The Lead and Copper Monitoring Plan is included in Appendix 10.11.

5.2.5 Nitrates

Annual Nitrate testing is performed at each of the systems sources. As of the most recent sampling in 2019, five of the seven wells have no detectable nitrates in the source water. One well has nitrate levels near the lower limit of lab detection, at 0.32 mg/L, and one well had a sample of 0.86 mg/L. The worst sample taken in the past 5 years was only 1/10th the MCL.

5.2.6 Radionuclides

In radionuclides samples taken between June 2015 and August 2016, no Radium or Alpha particle emission was detectable.

5.2.7 VOCs and SOCs

Samples have been tested for volatile organic compounds (VOCs) from each source in the past 6 years with no samples showing any detectable compounds from any of the system's 7 sources. Samples for synthetic organic compounds (SOCs) have had some detectible compounds but none above the MCL.

Chapter 6 Operations and Maintenance

6.1 Water System Management and Personnel

The authority for the water system is vested in the Board of Directors. The board of directors created a six-member Water Committee in 1976 to oversee the operation and maintenance of the water system. The six members of the water committee serve 3-year terms. The terms are staggered such that two new committee-people are elected at each annual membership meeting, so that there is never a complete change of the water committee during any single year.

At the behest of the Water Committee, the Lake Limerick Country Club staff provides billing and financial management services for the water system. Systems operations planning, scheduling and oversight are provided by the Lake Limerick Water System under the direction of the Water Manager. The Water Manager is the Primary Contact for the water system, is directly employed by the Lake Limerick Country Club and performs the day-to-day operations of the water system under the oversight of the Lake Limerick Water Committee.

6.1.1 Operator Certification

Lake Limerick Country Club has a population of approximately 2,000. The Washington Administrative Code requires systems with populations between 1,500 and 15,000 to be managed by a Water Distribution Manager with a Level 2 certification (WDM-2). The Water System Manager, Chris McMullen, has WDM-2, CCS, BAT and _certifications and is currently working on his WDM-3 certification.

Table 6-1: Summary of Certified Operators

Name	Position	Certifications	Number	Expiration Date
Chris McMullen	LLCC Water Manager and CCC Program Manager	WDM-2, CCS, BAT	009471	Dec-2025
Michael Boyd	LLCC Water Operator	WDM-1	015820	Dec-2025
Kevin Odegard	NWS Operations Supervisor	WDM-3, CCS, WDS, WTPO 1	006962	Dec-2025
Sean Burns	NWS Operations Assistant and Lead Field Technician	WDM-2, CCS	012946	Dec-2025

6.2 Operations and Preventative Maintenance

Routine operations are performed by the onsite Water Manager and Water Operator, who take daily source meter readings, reservoir checks, equipment inspections, and the monthly service meter readings. The Water Manager and Water Operator respond to concerns regarding leaks, high and low-pressure issues, and performs system maintenance. Billing issues are addressed by Water System administrative staff. If field work is required, such as confirmation of a meter reading, it is completed by the Water Manager and Operator.

LLWS prepares schedules of major system tasks, coordinates sampling, maintenance, system operations and responds to after-hours emergencies. NWS coordinated work to revise and initially implemented the cross connection control program, NWS provides backup support to LLWS and has technical and personnel resources to help complete tasks requiring more in-depth expertise or a larger workforce.

6.2.1 Normal Operating Conditions and Settings

Well and booster pump operation is governed by the SCADA system and can be controlled remotely from the water office and via mobile smart phones. Table 6-2 outlines the normal setpoints for the well pumps, reservoirs levels, and booster pumps.

Table 6-2: Normal Operating Conditions

Site	Well	Pumps To	On Level	Off Level	Booster Pump	Pressure at Entry to Distribution
1	Well 1	Tank 1	15.5 ft	20.5 ft	Booster 1	73 psi
2	Well 2	Distribution				88 psi
3	Well 3A/3B	Tank 3	21.0 ft	26.5 ft	Booster 3A/3B	62 psi
4	Well 4	Tank 4	22.5 ft	26.5 ft	Booster 4	75 psi
5	Well 5	Distribution				73 psi
6	Well 6	Tank 6	21.0 ft	26.5 ft	Booster 6A/6B	75 psi

6.2.2 Preventative Maintenance Schedule

The regular maintenance program is shown in Table 6-3, showing the task, frequency, and lead party. Those listed with both parties are done jointly, or by either party. NWS assists with other tasks as necessary. Some functions have also been taken over by the SCADA system, such as pump runtime, pressure, and tank level monitoring. Routine maintenance scheduling is coordinated using an electronic calendar on the Water Office computer.

Table 6-3: O&M Schedule

Task	Scheduled Frequency	Lead Party
Record Pump Hour Meters	Realtime, SCADA	Automatic
Record Reservoir Levels	Realtime, SCADA	Automatic
Record of System Pressures	Realtime, SCADA	Automatic
Read Source Meters	Daily	LLCC
Visual Inspection of stations	Daily	LLCC
Prepare Report to Water Committee	Monthly	LLCC
Read Service Meters	Monthly	LLCC
Water use Calculations	Monthly	LLCC
Billing	Monthly	LLCC
Clean / Sweep Pumphouses	Monthly, as needed	LLCC
Check Pressure Tank Pre-charges	Semi-Annual	LLCC
Exercise Generators	Monthly	Automatic
Inspect / Clean Generators	Quarterly	LLCC
Flushing	Quarterly	LLCC
Exercising Valves	Quarterly	LLCC
Hydrant inspection and testing	Quarterly	LLCC
Rotate Logbooks	Annual	LLCC
Air Release Valve Inspection	Annual	LLCC
Clean Reservoirs	Annual	LLCC Coordinates
Check Static Water Levels	Annual	LLCC
Cross-Connection Control:	Annual assembly testing, surveys performed on 5-year cycle	LLCC
Budget Evaluation	Annual	LLCC
Send Consumer Confidence Report	Annual	LLCC
Prepare WUE report	Annual	LLCC
WSP Updates	10-Year – Next update 2030	LLCC Initiates
Mason County Franchise Agreement	Every 10-years, next renewal 2029	LLCC

6.2.3 Equipment and Supplies

Lake Limerick maintains a selection of equipment and supplies for performing routine operations and maintenance tasks. Notable components are listed in Table 6-4.

Table 6-4: Equipment and Supplies

Item	Task Used For
Dell Laptops	SCADA, meter reading and office work
Badger Beacon Analytics Software and Hardware	Meter reading and reporting
Ford E-350 Water System Truck	System maintenance and repair
Ford E-450 Water System Truck	System maintenance and repair
1” and 2” Trash Pumps	Dewatering
Utility Trailers	Transport equipment
Power Roller	Street repair
Spare Parts	Parts necessary for maintenance
General Office Supplies	Billing, customer notification

6.3 Comprehensive Water Quality Monitoring

Water Manager and staff coordinate sampling from day to day based on availability. Two coliform samples are taken every month, except in the event of a failure, when the coliform monitoring plan is used to determine the location and number of repeat samples to be taken. The system is sampled in accordance with its Water Quality Monitoring Schedule (WQMS). The current WQMS Report (Appendix 10.11) provides the sample schedule, which is summarized below in Table 6-5.

Table 6-5: Sampling Schedule

Monitoring Group	Test Panel	Sample Location	Schedule/Status
Coliform	Coli	Distribution	Monthly
Asbestos	ASB	Distribution	9-year
Lead and Copper	LCR	Distribution	3-year
Nitrate	NIT	All Sources	Annual
Complete Inorganic Chemicals	IOC	All Sources	Waiver – 9-year
Iron	IOC	S02	3-year
Manganese	IOC	S02, S05, S07	3-year
Volatile Organic Contaminants	VOC	All Sources	Waiver – 6-year
Herbicides	Herb	All Sources	Waiver – 9-year
Pesticides	Pest	All Sources	Waiver – 3-year
Soil Fumigants	Fumigant	All Sources	Waiver – 3-year
Radionuclide / Gross Alpha	RAD 228	All Sources	6-year

6.3.1 Coliform Monitoring Plan and Map

The coliform monitoring plan was prepared by the system operator and NWS. The coliform monitoring plan can be found in Appendix 10.11. The system takes two routine samples per month from distribution. If there are any failures, repeat distribution samples and a source sample are taken per this plan. See the Coliform Monitoring Plan for details.

6.3.2 Disinfection Byproducts

Non-applicable for the Lake Limerick Water System.

6.3.3 Water Treatment Monitoring

Non-applicable for the Lake Limerick Water System.

6.4 Emergency Response Program

LLCC Water System Manager is the primary contact for after-hours water emergencies. LLCC and NWS have prepared a comprehensive emergency response program which is included in Appendix 10.2. The Water Office main phone number may be called 24/7 to report any water emergency. In the event of a call the Water System Manager evaluates the nature of the call and determines a best course of action. Emergency contact information is included in LLCC communications with the community, including Consumer Confidence Reports and Cross Connection Control Surveys. The contact list for the system is shown in Table 6-6.

LLCC is implementing a new phone system in early 2023 that will include an auto attendant to route calls to the appropriate departments including the Water Manager, Water Operator and emergency numbers. The phone system will also be able to notify appropriate contacts when there is a message waiting. Staff could also put a message on the phone system to provide updates on any events or emergencies.

The Water System includes a SCADA system that alerts the Water Department staff when there are alarms for abnormal conditions in the water system. They are alerted by text messages direct to their smart phones and they can use their smart phone to remotely monitor the situation and control the water system.

The Mason County Division of Emergency Management (DEM) has implemented an emergency notification system. Lake Limerick is one of the notification areas and Lake Limerick members can add their contact information to the list of those automatically notified of emergency situations. The Lake Limerick Office and the Water System Manager can post voice messages to be sent to all Lake Limerick members that have registered in the event of a water system emergency.

Table 6-6: Water System Contacts

Emergency contact	Phone number(s)	Emergency contact	Phone number(s)
Mason County Fire/Police/Medical	911	Electrician: Arcadia Drilling	888-426-3395
Mason County Emergency Management	360-427-9670 x811	DOH regional engineer	360- 236-3035
County environmental health	360-427-9670 x293	DOH emergency After hours #	877-481-4901
Department of Ecology Spill Response SW Regional Office	360-407-6300	Water Committee Chairperson (Contact LLCC Office for contact details)	360-426-4563
Engineering consultant Northwest Water	360-876-0958	Water Department Manager: Chris McMullen	360-507-6258
Electric utility: Mason Co. PUD 3	360-426-8255	Management Agency: NWS	360-876-0958
Pump service: Arcadia Drilling	888-426-3395	Water Office	360-426-4563
DOH Coliform Water Quality Monitoring: Charese Gainor	360-236-3045	LLCC Office	360-426-3581
DOH Chemical Water Quality Monitoring: Sophia Petro	360-236-3046	Control Systems: Coast Controls	360-310-0107

6.4.1 Vulnerability Assessment

Earthquake – No practical degree of protection against catastrophic earthquakes can be supplied; however, the system has numerous redundant sources, a large volume of water storage, control valves to disable sections of the system, and on-site backup power facilities at multiple sites. The system is therefore expected to be able to withstand typical minor earthquake events. After an earthquake has occurred, the system shall be carefully inspected and an inventory of all damages shall be made. Additional water quality testing will be performed in consultation with the WSDOH.

Fire – In the event of a fire in a pumphouse, 911 shall be notified. Once the emergency responders have deemed the area safe to enter, the site is to be disabled during inspection. If it is found to be safe after inspection, the site may be re-enabled. If minor repairs are necessary, the Water System Manager will contact the appropriate company for a service call.The system will operate without problem with any of the 6 sites offline, down-time at any single site can be tolerated for extended periods for repairs. If extensive damage has been done and the site must be replaced, the system may take the opportunity to re-engineer the site if damage from the fire could have been averted through practical measures.

Flood – The system is located surrounding a lake; however, none of the streams are of sufficient size to indicate a likely flood risk. All sources are above the 100-year floodplain. Primary risks from flooding would be washed-out culverts, which could cause a waterline break. In the event of a flood related break, the area would be isolated by valves, the waterline repaired and chlorinated, and the system may be placed on precautionary boil water advisory while the extent of potential contamination from surface water is evaluated.

Power Outages – The system's 2 primary sites with backup power will prevent power outages from disabling the community sources or pressure systems.

Vandalism/Terrorism – Small water systems are potential targets of vandalism and terrorism. Fortunately, most small water systems also attract little attention. Wellheads, pumphouses, and reservoirs[9] are secured with locks or fences with locked gates. Any evidence of vandalism shall be investigated and water quality samples shall be taken if there appears to be any evidence of tampering with the wellheads, pumphouse, reservoirs or other point at which contaminants could enter the system. After-hours security patrols are aware of the locations of water sources and provide a deterrent for vandals.

Volcanic Activity – Because of the system's location, vulnerability to volcanic activity is very low. The most likely impact of volcanic activity would be ash fallout from a regional event. This fallout could potentially impact water quality of open reservoirs; however, all of the reservoirs serving Lake Limerick are concrete or steel silos with enclosed roofs, locked sealed lids, and downward facing screened vents. Volcanic ash is therefore unlikely to present any problem for the system.

Public Health Crisis / Pandemic – Public water systems require ongoing maintenance and operational oversight by on-site personnel. Typically, administrative and operational duties are spread among several individuals, with many possible shared spaces and surfaces (i.e. offices, break rooms, restrooms, maintenance shop, etc.). In the event of a public health crisis or pandemic, it may be necessary to operate the system while preventing direct or indirect interaction between system employees and customers. The SCADA system allows for routine monitoring to be performed from the central office and remotely via smart phone. Source redundancy provides flexibility in performing maintenance and repairs. Additionally, the system has implemented drive-by meter reading technology. Vulnerability to public health crises is therefore low, as the system would be able to maintain normal service while abiding by social distancing measures and minimizing the spread of pathogens between surfaces. Furthermore, there is no threat to the drinking water, as there is no natural pathway for viruses or bacteria to enter the water supply.

Personal Safety – Water system personnel should be aware of potential hazards related to the water system and ensure the appropriate safety measures are in place. Pumphouses have moving equipment and high voltage power supply, however, they are well protected. Power to pumps, controllers, or any other electrical equipment should be physically disconnected before repairing or replacing any equipment. Electrical panel and motor control covers should be kept in place at all times. Reservoirs can pose a fall concern, but are equipped with locked climbing cages and guardrails, and are fenced off from the public. Reservoirs and vaults are considered and confined spaces and should only be entered by persons who have received confined spaces training. Additional confined space information is available at osha.gov. The Lake Limerick main office is

[9] The reservoir at Site 3 has a fence that needs to be completed. This is part of the improvement program discussed in Chapter 8.

equipped with a first aid kit; additionally, Water System staff receive emergency training and their vehicles are equipped with first aid kits.

6.5 Cross-Connection Control

The system has an adopted Cross-Connection Control Program that was implemented by NWS. The cross-connection control policy, program, and list of backflow devices can be found in Appendix 10.12.

6.6 Sanitary Survey Findings

The latest Sanitary Survey was performed in October 2018. There were no significant deficiencies or significant findings identified during the survey. An observation was made that the walls of the booster station at Site 5 appeared to be mildewed and there was some insulation on the floor. Cleaning and repair of the pumphouse has been added to the list of improvement items in Chapter 8. The complete sanitary survey is included in Appendix 10.16.

6.7 Record Keeping, Reporting, and Customer Complaint Program

The system generates a number of different types of records that must be kept. The water system maintains these records. The records and the periods over which records are maintained are shown in Table 6-7, Table 6-8, and Table 6-9.

Table 6-7: Billing Records

Type of Record	Time Kept	Reporting
Utility Billing Records	3 years	n/a
Receipts	3 years	n/a
Power Bills	3 years	n/a
Check Registers	3 years	n/a
Taxes and Financial Reports	7 years	n/a

Table 6-8: Planning and Administrative Records Maintained

Type of Record	Time Kept	Reporting
System Planning Documents	Until Irrelevant	As Requested
Engineering Drawings	Indefinitely	As Requested
WFI	Current	Annually
Contracts	as necessary	n/a
Work Orders	3 years	n/a
Operating Permit	Current	n/a
Correspondence with Customers	3 years	Upon Request
Correspondence with Government	3 years	n/a
Correspondence RE: Sanitary Surveys	10 years	Upon Request
Record of Action to Correct Violations	3 years	Upon Request
Misc. Correspondence	3 years	Upon Request
Consumer Confidence Reports	3 years	Annually
Site Visit Reports	1 year	Upon Request
Record of Public Notices	3 Years	Upon Request

Table 6-9: Water Quality Records

Type of Record	Time Kept	Reporting
Bacteriological Tests	1 year	Monthly
Coliform Monitoring Plans	5 years after retirement	As Requested
CCC Documents	3 years	Upon request
Exemptions and Variances	5 years after expiration	As Requested
Nitrate Tests	5 years	Annually
IOC	Indefinitely	Upon testing
VOC/SOC	Indefinitely	Upon testing
Radionuclide	5 years	Upon testing
Lead and Copper	12 years	Upon testing
Other Water Quality	5 years	Upon testing
Backflow Testing	1 year	Upon request
Site Visit Reports	1 year	upon request
Work Orders	3 years	n/a
Water Well Reports	Indefinitely	Upon request
Drawdown Tests	Indefinitely	Upon request
Static Water Levels	20 years	Upon request
Source Meter Readings	3 years	Upon request

6.7.1 Customer Complaints

Complaints regarding water service issues may be directed to the LLCC Office or the Water office during regular business hours or after-hours emergencies. The Water Manager is available on a 24-hour basis for emergency response. The Water Manager or Water Operator investigate each complaint and maintains records describing the nature of the complaint and the steps taken to resolve it. The Water Manager coordinates with the Lake Limerick Community Association Manager, Water Committee and Board of Directors to ensure that they are aware of any issues and their resolution.

6.8 Summary of O&M Deficiencies

The system has sufficient capacity to provide water service through full build-out of the community, including the possible eventuality of all the homes becoming full time residences. The system has excellent water quality, and water use efficiency efforts have yielded significant savings for the community. Overall, the system is well maintained and repairs and upgrades are routinely made. Portions of the SCADA system, which was identified as a deficiency in the 2012 WSP, have been upgraded and additional improvements are planned. No significant system deficiencies were identified during the most recent Sanitary Survey. However, several "minor" deficiencies have been identified and are listed below.

6.8.1 Service Meter Data Accuracy

In preparing the current water system plan, the system's service meter records were analyzed to determine the current ERU count and average demand values. This analysis required thorough investigation of all customer usage records. While the vast majority of the records appear "normal" and in-line with what we would expect, there were a handful of accounts that had large inaccuracies in the data reported from the Utility Management Solutions (UMS) software. For example, certain accounts showed negative water use for the billing period, while others show very large values that are several orders of magnitude larger than realistically possible (i.e. millions of gallons per month). These errors occurred in multiple customer accounts and several years indicating insufficient audits were being performed.

The Utility Management System software was upgraded in early 2022 with the Ampstun Utility Billing System. During that process the Ampstun meter database and Badger Beacon software database were audited to verify that meter records were correct. Previously there was a mismatch in some records regarding whether the meters were reading in gallons, tens of gallons or tenths of gallons. These mismatches have been resolved and all meters are reading in gallons or tenths of gallons (depending on the accuracy of the meter) and the databases updated accordingly. Procedures have been put in place to catch the anomalies in the meter readings prior to saving the data and billing the customer.

6.8.2 Clean and Repair Pumphouse 5

As noted above in Section 6.6, the Sanitary Survey found that some cleaning and repairs in Pumphouse 5 should be done.

6.8.3 Install Dedicated Sample Stations for Bacteriological Testing

The system has historically sampled from hose bibs throughout the community, which are prone to producing false positives. Dedicated sample stations should be installed to reduce the potential for false positives.

6.8.4 Install New Backup Generator at an Additional Well Site

The existing generator at Site 2 is too old to be adequately maintained. The system has proposed replacing it with a new generator at an existing site to be determined.

6.8.5 Replace Well 5 Pump

The pump installed in Well 5 is not well suited for its operating condition. The pump is designed for operation above 150 gpm, but as configured it pumps at a higher pressure and only at 35 gpm. This causes the pump to operate at significantly reduced efficiency. Although this does not directly impact water service to customers, it is recommended that replacement of the pump be reviewed to determine if the electrical savings of a more appropriately sized pump justifies replacement prior to the existing pump's end of life.

6.8.6 Distribution System and Fire Hydrant Replacement

The existing fire hydrants throughout the system are no longer manufactured, meaning that direct replacement will not be possible. Although fire flow is not currently required, the community has chosen to increase looped lines to 6" and dead-end lines over 250 feet in length with 8" main lines whenever they are replaced so that fire flow may eventually be supported. Therefore, the hydrants should continue to be maintained, and replaced when they reach the end of their service life. NWS recommends replacing the existing hydrants with M&H Reliant Style 929, Mueller Centurion, or Clow Medallion when necessary. In the event that an existing hydrant is damaged, the Water System has purchased two new hydrants and appropriate extensions to keep as spare parts.

Chapter 7 Distribution Facilities Design and Construction Standards

The Lake Limerick Water System desires exemption from project report and construction document submittal per WAC 246-290-125 for distribution main projects. All distribution replacements, upgrades, and modifications shall comply with the standards and details contained herein. The Water System Service Area Maps are available in Appendix 10.1 as they exist in July of 2020. In requesting these exemptions, the Lake Limerick Water System will:

- Maintain an approved Water System Plan with the Department of Health that includes standard construction specifications for distribution mains and an analysis of the hydraulic capacity of the basic distribution main configuration.
- Maintain a project summary file and construction documentation for each system improvement under this exception. This summary file will be available to the Department of Health upon request and will include as-built drawings and a completed *Construction Completion Report for Distribution Main Projects* signed by the design engineer.

The community shall upgrade waterlines as they are replaced. At this time no large single replacement project is proposed. The community instead intends to replace sections of lines as they begin to fail. The system plans to replace all waterlines over the course of 30 years and then begin a program of preventative replacement on a 60 to 80-year schedule after the initial phase of replacement is completed. As it is replaced, the distribution system shall be resized to support fire flow. All looped waterlines shall be replaced with 6" or 8" PVC or HDPE (high density polyethylene), and all dead ends over 250 feet in length shall be replaced by 8" waterlines.

7.1 Project Review Procedures

All distribution projects shall be designed and stamped by a professional engineer. All projects not included in the submittal exception shall be submitted to the WSDOH for their review and approval. Any construction begun prior to WSDOH approval may be subject to fines.

The following projects do not require a project report and may be completed at the system's discretion, as long as the work is consistent with the standards set forth in this design.

- Addition of valves, fittings, service connection, meters
- Repair or replacement of any components with like components
- Maintenance of existing components
- Construction of any component not in contact with potable water

All construction of new or replacement facilities shall be subject to the following specifications:

- The current Standard Specifications of the Washington State Department of Transportation
- American Water Works Association (AWWA) standards
- Applicable standards adopted under Washington Administrative Code
- Mason County road and utility installation standards
- Standard plans and details adopted by the Lake Limerick Water System.

The system will require plans and specifications for any new project not described here to be prepared in writing under the supervision of a registered professional engineer and approved by the State Department of Health prior to construction. Future reports prepared and stamped by a licensed professional engineer may modify these standards. All projects shall be reviewed and certified by the design engineer. These standards and details supersede the corresponding details and standards from the 2012 Water System Plan.

7.2 Policies and Requirements for Outside Parties

No outside parties are permitted to work on the system unless specifically contracted to complete work under the direct supervision and direction of the system.

7.2.1 Design Documents

All design documents shall be completed and stamped by a professional engineer and submitted to the WSDOH for review and approval. Designs shall specify materials and methods conforming to the WAC, WSDOH, AWWA, and WSDOL professional standards. Special attention shall be paid to the WSDOH Design Manual, applicable AWWA Manuals, and 10 States Standards. In the event that conflicting standards are presented the most conservative standard shall be adopted. If a standard other than the most conservative standard is proposed engineering justification for the more lenient standard must be provided. All system components in contact with potable water shall conform to NSF 61 standards.

7.2.2 System Hydraulics

- The system shall be designed such that all lines are looped whenever possible.
- All dead-end lines shall have blowoff assemblies.
- The system high point shall have an air release valve.
- Pressures throughout the system shall be maintained between 30 and 100 psi.
- Pipe flow velocities shall remain below 2.5 ft/sec unless higher flow rates can be justified.
- All designs shall take into consideration the possibility of future expansion.

7.2.3 Redundancy

Redundancy shall be provided for source and pressurization of water service. Redundant features include:

- Multiple wells and well pumps
- Multiple reservoirs and booster pumps
- Multiple backup generators

7.3 Construction and Design Standards

All construction shall be completed according to the standards set forth in the WAC, WSDOH, AWWA, and 10 States Standards. If conflicting standards are presented, the most conservative standard shall be adopted. If a standard other than the most conservative standard is proposed, engineering justification for the more lenient standard must be provided.

The following specific standards must be maintained:

- Pipe sizes under 4-inch shall be a minimum of Schedule 40 PVC or DR 11 HDPE
- Pipe sizes 4-inch and above shall be a minimum of AWWA C900
- All valves and fittings shall be the same size as the run of pipe they are serving
- All blow-offs, service connections, and trench details shall at a minimum conform to the "standard details" as shown in Appendix 10.20
- Trench depths shall be no more than 4-feet
- Disinfection shall be followed according to the standard details as shown Appendix 10.20

7.3.1 Construction and Design Standards for Water Mains

Standard details and drawings for water main installation are included in Appendix 10.20

7.3.2 Construction and Design Standards for Reservoirs and Booster Pump Stations

The Lake Limerick Water System is not requesting submittal exception for distribution related projects, such as reservoirs and booster pump stations. Construction and design standards for these elements are not included in this water system plan.

7.4 Construction Certification

The design engineer will inspect and certify construction at all applicable phases to ensure the project is constructed in accordance with the construction standards. These phases shall include:

- Completion of Trenches
- Pipe Installation
- Disinfection
- Pressure Testing
- Final Inspection
- Water Quality Sampling

Some of these inspections may be combined into a single visit, if applicable.

The water system will maintain a project file to include all design and constriction record drawings.

Following construction completion, the certifying engineer shall submit a construction completion report to the WSDOH.

- The *Construction Completion Report Form DOH 331-121* shall be used for normal projects that underwent DOH review and approval and was constructed in accordance with the DOH-approved design.
- The *Construction Completion Report for Distribution Main Projects DOH 331-147* shall be used only for distribution main projects not requiring prior written approval from DOH. This from does not have to be submitted to DOH following construction completion, but the water system must maintain a competed form on file and make it available to DOH upon request.

Any deviations from the submitted design shall be addressed and documented by the submitting engineer in the design report. If completion of the project changes any information on the Water Facilities Inventory (WFI), the system must submit an updated WFI with the signed construction completion report.

Chapter 8 Capital Improvement Program

8.1 Prioritization Criteria

Improvements are prioritized according to the following criteria listed from highest to lowest in importance:

1. Public Health Risks
2. Adequate Supply
3. WSDOH Operation and Design Standards
4. Achieving Conservation Goals
5. Regularly Scheduled Improvements
6. Aesthetic and Optional Improvements

8.2 Prioritized List of Improvements

The system has no significant public health risks, has an adequate supply, and meets or exceeds all WSDOH guidelines for operation and design standards. Therefore, the highest three prioritization criteria are already met and the following improvements are prioritized based on the remaining criteria (4-6) as well as project scope and cost.

1. Water Office Improvements and Expansion
2. Improve Service Meter Data Accuracy
3. SCADA System Improvements
4. Install Dedicated Sample Stations for Bacteriological Testing
5. Clean and Repair Lower Pumphouse at Site 3
6. Upgrade Well #2 electrical and add filtration
7. Install Backup Generator at an existing site to be determined
8. Replace Well Pump at Well #5
9. Improve Water System Infrastructure
10. Add Low-Level Chlorination to System When Required

8.3 Assessment of Improvements [*** reorder the paragraphs below to correspond to prioritized list]

8.3.1 Water Officee Improvements and Expansion

The current Water System office is inadequate to support two Water Department staff and the functions that they are required to perform. The current office is located in the Maintenance Shop building that also houses Facilities, Greens, Mechanic personnel and a garage area for vehicle maintenance. Planning is in the works to provide a larger office to support the Water Office and, possibly, other maintenance personnel that will be separate from the vehicle maintenance garage. This will provide space for the Water Operator, greater productivity, better working conditions and improved SCADA and other electronic equipment security.

8.3.2 Improve Service Meter Data Accuracy

The service meter records from recent years contained occasional erroneous readings, such as negative water use or amounts that were several orders of magnitude larger than should be expected. This is being corrected for all meter reads by performing regular "audits" of the data or setting filters in the reporting software to automatically flag outlying data points. Ensuring data accuracy allows for a more accurate summary of monthly and annual water use and more efficient analysis for future design or planning documents. In early 2022, the water billing system was upgraded to the Ampstun Utility Billing program. This provided a number of additional reports that allowed for better checking of meter reading accuracy. It also integrated better with the new Badger Beacon meter reading software.

8.3.3 SCADA System Improvements

In 2018 the SCADA system PC was upgraded to a new Dell workstation running Windows 10 Pro, and the Wonderware SCADA software was upgraded to version 2017. The system has indicated their desire to make some additional improvements. The current SCADA system monitors and controls pump runtime, pressure, and reservoir levels. The system would like to incorporate real-time source meter readings and aquifer levels into the SCADA program, as well as a setting to automatically turn off well site booster pumps if the reservoirs reach low level. This will allow for increased awareness of instantaneous and historical well performance to help identify seasonal or long-term trends and catch operational errors early on.

8.3.4 Clean and Repair Pumphouse at Site 3

The latest Sanitary Survey, performed in October 2018, found that the lower booster pump house at Site 3 appeared to have mildewed walls and pieces of insulation on the floor. Well site 3 was misidentified as site 5 in that report. This could indicate that the pumphouse is not sealed adequately, leading to a buildup of moisture and potential access to rodents. The system should take action to seal the pumphouse to protect from rodents and moisture intrusion, and clean or replace the affected walls.

8.3.5 Install Dedicated Sample Stations for Bacteriological Testing

As noted in Chapter 5, bacteriological samples have historically been taken from outdoor hose-bibs, which are prone to producing false positives. Dedicated sample stations will be installed to reduce the number of false positives.

8.3.6 Upgrade Well #2 Electrical and Add Filtration if Needed

At Well #2 there are several electrical issues that need to be addressed including decommissioning the emergency generator and reconfiguring the electrical circuits, upgrading the circuits to current NEC requirements, installing a new VFD to control the well pump, and upgrading the control equipment that is currently in that location. While the work is being done, consideration needs to be given to implementing filtration for high levels of iron and manganese that prevents the well site from being used during normal operations. The filtration would be designed to provide equivalent water quality to the other well sites and limit the negative effects of the iron and manganese. That will allow the water rights associated with that well site to be utilized more effectively.

8.3.7 Install Backup Generator at an Existing Site to be Determined

The system currently has three backup generators, one each at Site 2, Site 3, and Site 6. However, the generator at Site 2 is too old to be adequately maintained and is being decommissioned. A new generator is proposed at a site to be determined as a replacement.

8.3.8 Add Low-Level Chlorination to the System

The Lake Limerick Water System is not required to chlorinate any sources. However, LLCC would like to evaluate installation of chlorination equipment to maintain a low-level residual throughout the system. The scope and schedule of this project is yet to be determined, but is mentioned here for the sake of plan completeness. The Water System will consult with an engineer and the Department of Health prior to beginning any treatment project.

8.3.9 Replace Pump in Well 5

Water is pumped from Well #5 by a 10-HP pump designed for operation above 150 gpm. At higher pressure the pump delivers lower flow rates at reduced efficiency. The well pump is rated for efficiencies above 65%, but is likely operating at just 30% efficiency as configured. The well pump delivers approximately 10 to 15% of total production; assuming a new pump would operate at twice the efficiency, thereby requiring half the electrical usage, a savings of $1,000 – $1,500 per year in electrical costs could be expected. With an estimated remaining life of 14 years and replacement cost of $20,000, it may be nominally cost effective to proactively replace the pump. However, it is unlikely that the electrical savings would be substantially more than the replacement cost. Therefore, pump replacement is not anticipated within the 10-year planning horizon. The pump should be reviewed by an engineer, and a more appropriately sized pump should be specified prior to replacement.

8.3.10 Water System Infrastructure Improvements

The community is currently served by over 78,000 feet of waterline, almost all of which is asbestos cement. Most of the waterline was installed in the 1960s and 1970s and will likely be nearing the end of its useful life in the next couple of decades. The waterline will likely require significant portions or even complete replacement within the next 20-25 years. The community should continue to fund a capital reserve program that will be capable of replacing the waterlines and hydrants within that time frame. Circumstances over the last three years including the pandemic, high inflation and supply chain issues make accurate cost projections difficult.

20-25 years is only a best estimate of the remaining useful life of the waterline. It is possible that the distribution system will develop significant leak problems and require replacement before this period. It is also possible that the system could out-live this estimate. The most likely outcome is that portions of the system will require replacement sooner than others and that work may be spread over several projects performed over a number of years.

Since it is not always possible to know ahead of time where replacements will be required first, the community should set a reserve budget that can accommodate the complete replacement of the system in 25 years. With these funds on hand, the system can conduct regular evaluations of the waterline condition and use these capital reserves to replace the system as necessary. The best way to assess the condition of the system and

determine where replacement will likely be necessary next is to monitor the frequency and location of breakages and the overall leakage rates. Installation of zone meters can also be useful in determining the vicinity of leaks and pipe condition in certain areas of the distribution system. If at any time the need to replace exceeds the community's financial capacity, federal, state, and private loan programs are available that could be used to complete the project. When waterlines are replaced, they will be sized to support fire flow, and asbestos cement pipe will be replaced with C900 PVC.
The model of the existing fire hydrants is no longer manufactured. Although fire flow is not currently required, the system will be upgrading the distribution system when it is replaced to support fire flow. Therefore, the fire hydrants should be replaced when they reach the end of their service life. NWS recommends replacing the existing hydrants with M&H Reliant Style 929, Mueller Centurion, or Clow Medallion. It is anticipated that the hydrants will be replaced within the next 20 years, but not within the next 10-year planning cycle.

There is a railroad primarily serving Navy facilities in the Bremerton Washington area that crosses the Lake Limerick development in two locations – one crosses Mason Lake Rd. over a trestle, the other crosses St. Andrews Dr. at grade with crossing arms. The Navy is contracting to perform seismic upgrades to the railroad trestle crossing Mason Lake Rd. which will impact the major water line circling Lake Limerick. During the construction, a temporary waterline will need to be installed between Olde Lyme Rd. and Mason Lake Rd. underneath the railroad trestle outside of the construction zone. As part of the construction, a permanent waterline will need to be installed under Mason Lake Rd. to restore the waterline loop around Lake Limerick. A specific timeline for the construction is not available at this time. Engineering drawings for the proposed temporary and permanent waterlines are included in the appendices.

8.4 Improvement Program Summary and Schedule

The community will perform all of the upgrades proposed in section 8.3. Only the first six improvement projects are anticipated within the next 10 years, with the remaining improvements being made when the existing equipment is replaced at the end of its service life. While the last four upgrades are not anticipated within the 10-year planning period, the financial program should be prepared to adequately plan for these future projects.

Table 8-1 provides an overview of the possible schedule for capital improvements projects. See Chapter 9 for details of the financial program. Circumstances over the last three years including the pandemic, high inflation and supply chain issues make accurate cost projections difficult.

Table 8-1: Improvement Schedule [* reorder and renumber as necessary]**

Improvement	Estimated Cost (2020 dollars)	Schedule	Source of Funds
1. Water Office Improvements	$50,000	2023	Operating
2. Improve Service Meter Data Accuracy	$20,000	2022	Operating
3. SCADA System Improvement	$40,000	2022-23	Reserves
4. Clean and Repair Pumphouse 3	$5,000	2023	Reserves
5. Install Dedicated Sample Stations	$10,000	2022	Reserves
6. Upgrade Well #2 Electrical and Filtration	$30,000	2023-24	Reserves
7. Install Backup Generator at Site 4	$90,000	2023	Reserves
8. Install Chlorination Equipment	Scope and schedule not yet determined		
9. Well 5 Pump Replacement	$20,000	2034	Reserves
10. Distribution Line Replacement	$5,300,000	2042	Reserves[10]
11. Fire Hydrant Replacement	$270,000	2040	Reserves

[10] Capital reserve program shall be established to provide sufficient funds to replace the distribution system in 20-25 years; should replacement become necessary prior to this time, a one-time community assessment, or loans through federal and state programs may be used to supplement the reserves as necessary.

Chapter 9 Financial Program

The Lake Limerick Water System is operated as a financial subcomponent of the broader Lake Limerick Country Club. The system collects revenue from metered water rates, unmetered lots (ready to serve fees), locked meter fees, disconnection charges, excessive use charges, new connection fees, and interest from long term investments. Rates for the 2019-2020 fiscal year were as follows (per user):

Table 9-1: FY 2019-2020 Rate and Fee Structure

Metered Lot (10,000 gallons per month base allocation)	$30.00/month
Locked Meter	$16.00/month
Unmetered Lot	$16.00/month
Half-Lot, Metered (5,000 gallons per month base allocation)	$14.00/month
Half-Lot, Unmetered	$8.00/month
Excessive Use (Over Base Allocation)	$2.00/1,000 gallons
New Valve and Meter Installation (includes water spigot upon request)	$1,000.00
Spigot Installation (customer side, past meter and backflow devices)	$175.00
Lockout (reduces monthly fee to $16.00)	$60.00
Return to Service (increases monthly fee to $30.00)	$60.00
Hose Bib Lock	$15.00

A rate increase was proposed to adequately fund the long-term asset reserves for future waterline replacement. The waterlines are expected to need replacement within the next two decades. Current funding rates of the long-term reserve would not be adequate to cover the expected cost of mainline replacement without the use of loans or special assessments. Since the previous water rate was relatively low, a rate increase and adjustment to the rate structure to a more tiered approach was proposed, along with ongoing adjustments each year to keep pace with inflation.

Table 9-2: Recommended Rate Structure

Tier	Use Range	Rate	Estimated Average Fee
Base Rate	0 - 6,000 gal	$40.00	$40.00
Tier 1	6,001 - 10,000 gal	$2.75 / kgal	$2.53
Tier 2	10,001 - 15,000 gal	$3.75 / kgal	$2.04
Tier 3	above 15,000 gal	$4.75 / kgal	$4.04
Total			**$48.61**

In 2020, the financial analysis in this chapter was prepared upon the assumption that the recommended rates would be implemented with ongoing annual inflation adjustments of 3%. It has also been assumed that the community will invest its long-term replacement reserves in accounts earning 0.5% less than inflation as a conservative estimate. The model was prepared using estimated life spans shown in the system inventory in Appendix 10.5. As previously noted, circumstances over the last three years including the pandemic, high inflation and supply chain issues make accurate cost projections difficult.

In 2020, the Water System implemented a similar tiered rate structure based on the recommendations from NWS with some adjustments including a lower base water rate of $27 but also including separate reserves of $8 making the total base amount $35 per month. The resulting rate and fee structure is as follows:

Table 9-__: FY 2020 -2021 Rate and Fee Structure

Monthly Charges				
Full Metered Lot				
Tier	**Use Range**	**Rate**	**Reserves**	**Total**
Base Rate	0 - 6,000 gal	$27.00	$8.00	$35.00
Tier 1	6,001 - 10,000 gal	$2.75 / kgal		calculated
Tier 2	10,001 - 15,000 gal	$3.75 / kgal		calculated
Tier 3	15,001 gal and above	$4.75 / kgal		calculated
Total			**$8.00**	**$35.00**
Non-metered Lot		**$10.00**	**$8.00**	**$18.00**
Locked Meter Lot		**$10.00**	**$8.00**	**$18.00**
Non-metered Half Lot		**$5.00**	**$4.00**	**$9.00**
Fees				
New Meter Installation				**$1,500.00**
Meter Lockout				**$60.00**
Meter Return to Service				**$60.00**

The Water System adjusted the rates annually in order to generate sufficient revenue for the projected operating costs and capital project costs that were budgeted in the annual budget process. Each year a number of scenarios were evaluated so that the projected income would match the budgeted amounts. During the budgeting process the members were able to voice their concerns and their input was taken into account. The HOA members vote on the Water Budget annually. The rate and fee structure for the 2022-2023 fiscal year is as follows:

Table 9-__: FY 2022 -2023 Rate and Fee Structure

Monthly Charges				
Full Metered Lot				
Tier	**Use Range**	**Rate**	**Reserves**	**Total**
Base Rate	0 - 6,000 gal	$42.00	$12.00	$54.00
Tier 1	6,001 - 8,000 gal	$4.00 / kgal		calculated
Tier 2	8,001 - 10,000 gal	$5.00 / kgal		calculated
Tier 3	10,001 - 15000 gal	$6.00 / kgal		calculated
Tier 4	15,001 - 20,000 gal	$7.00 / kgal		calculated
Tier 5	20,001 gal and above	$8.00 / kgal		calculated
Total			**$12.00**	**$54.00**
Non-metered Lot		**$17.00**	**$12.00**	**$29.00**
Locked Meter Lot		**$17.00**	**$12.00**	**$29.00**
Non-metered Half Lot		**$8.50**	**$6.00**	**$14.50**
Fees				
New Meter Installation				**$3,000.00**
Meter Lockout				**$60.00**
Meter Return to Service				**$60.00**

9.1 Financial Viability

In order to remain financially viable, water systems must commit to identifying the full cost of providing water service, recovering that cost through regularly adjusted service rates and fees, and maintaining adequate reserve funds. Without adequate financial capacity, it becomes difficult or impossible to maintain adequate operational and managerial capacity to provide a safe and reliable water supply. Lake Limerick has detailed income and expense records and develops a balanced operational budget for each fiscal year. The following sections address each of these elements and provide information on how to maintain an appropriate level of funding for both ongoing and long-term expenses.

9.2 Income and Expenses

9.2.1 Income

The existing fee structure described above resulted in $495,900 of system revenue of about $470,000 in 2020. Following the rate increase in October 2020, system revenue was just over $600,000 including reserves. The water system then increased its rates in accordance with its actual annual increases in operating expense. Revenue for fiscal year 2021-2022 was just over $830,000.When estimates were originally made in 2020 it was assumed that 3% annual rate increases would be sufficient to meet this need. The projected revenue based on 3% growth in expenses for the system over the 10 years from 2021 to 2030 is shown in Table 9-3. Actual growth in expenses will be monitored on an annual basis and adjusted by the LLCC Water System Committee. If inflation continues as it has in the last 2 years, projected revenues will have to be revised upwards to reflect inflation-adjusted costs.

Table 9-3: Lake Limerick Water System Estimated Revenue

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Water Rates - Metered	$566,400	$583,392	$600,894	$618,921	$637,488	$656,613	$676,311	$696,601	$717,499	$739,024
Water Rates - Unmetered	$ 2,500	$ 2,575	$ 2,652	$ 2,732	$ 2,814	$ 2,898	$ 2,985	$ 3,075	$ 3,167	$ 3,262
Disconnect, Lockout, and Locked Meter fees	$ 3,000	$ 3,090	$ 3,183	$ 3,278	$ 3,377	$ 3,478	$ 3,582	$ 3,690	$ 3,800	$ 3,914
Excessive Use Fees	$124,100	$127,823	$131,658	$135,607	$139,676	$143,866	$148,182	$152,627	$157,206	$161,922
New Connection Fees	$ 1,030	$ 1,061	$ 1,093	$ 1,126	$ 1,159	$ 1,194	$ 1,230	$ 1,267	$ 1,305	$ 1,344
Miscellaneous Revenue	$ 2,000	$ 2,060	$ 2,122	$ 2,185	$ 2,251	$ 2,319	$ 2,388	$ 2,460	$ 2,534	$ 2,610
Total	$699,030	$720,001	$741,601	$763,849	$786,764	$810,367	$834,678	$859,719	$885,510	$912,076

9.2.2 Expenses

Table 9-4 shows the operating expenses over the next 10 years as estimated in 2020 . Water rates were assumed to increase at 3% per year in accordance with projected inflation. As previously noted, circumstances over the last three years including the pandemic, high inflation and supply chain issues make accurate cost projections difficult. Sampling and engineering expenses tend to fluctuate. For example, over the next decade most engineering fees will be incurred during preparation of the Water System Plan and IOC sampling for all wells.. The amortized average annual cost for these variable fees has been included in the table rather than making specific provisions for any specific year or project. A Water Operator position was added in 2021 which increased labor expenses.

Actual expenses for fiscal year 2019-2020 were about $365,000. Expenses in fiscal year 2020-2021 were about $475,000. Expenses for fiscal year 2021-2022 were about $477,000.

Table 9-4: System Expenses

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Automobile Expenses	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159
Bank Service Charges	1,236	1,273	1,311	1,351	1,391	1,433	1,476	1,520	1,566	1,613
Computer and Internet	515	530	546	563	580	597	615	633	652	672
Dues and Subscriptions	2,060	2,122	2,185	2,251	2,319	2,388	2,460	2,534	2,610	2,688
Employee Expenses	136,063	140,145	144,349	148,680	153,140	157,734	162,466	167,340	172,361	177,531
Equipment Rental	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376
General Liability	21,115	21,748	22,401	23,073	23,765	24,478	25,212	25,969	26,748	27,550
Interest Expense	1,100	700	300	0	0	0	0	0	0	0
License and Permits	2,266	2,334	2,404	2,476	2,550	2,627	2,706	2,787	2,871	2,957
Meals and Entertain.	309	318	328	338	348	358	369	380	391	403
Merchant Acct Charges	2,472	2,546	2,623	2,701	2,782	2,866	2,952	3,040	3,131	3,225
NSF Check Fees	309	318	328	338	348	358	369	380	391	403
Office Supplies	824	849	874	900	927	955	984	1,013	1,044	1,075
Office Expense	1,545	1,591	1,639	1,688	1,739	1,791	1,845	1,900	1,957	2,016
Postage and Delivery	4,635	4,774	4,917	5,065	5,217	5,373	5,534	5,700	5,871	6,048
Professional Fees	50,000	51,500	53,045	54,636	56,275	57,964	59,703	61,494	63,339	65,239
Repairs and Maint.	20,000	20,600	21,218	21,855	22,510	23,185	23,881	24,597	25,335	26,095
Service Contracts	3,296	3,395	3,497	3,602	3,710	3,821	3,936	4,054	4,175	4,301
Small Tools and Equip.	4,120	4,244	4,371	4,502	4,637	4,776	4,919	5,067	5,219	5,376
Supplies	12,360	12,731	13,113	13,506	13,911	14,329	14,758	15,201	15,657	16,127
Taxes - Property	100	103	106	109	113	116	119	123	127	130
Taxes - Public Utility	15,450	15,914	16,391	16,883	17,389	17,911	18,448	19,002	19,572	20,159
Telephone	1,957	2,016	2,076	2,138	2,203	2,269	2,337	2,407	2,479	2,553
Travel Expense	515	530	546	563	580	597	615	633	652	672
Uniforms	1,030	1,061	1,093	1,126	1,159	1,194	1,230	1,267	1,305	1,344
Utilities	21,630	22,279	22,947	23,636	24,345	25,075	25,827	26,602	27,400	28,222
Water Testing	5,150	5,305	5,464	5,628	5,796	5,970	6,149	6,334	6,524	6,720
General Expense Total	**329,627**	**339,083**	**348,834**	**358,990**	**369,760**	**380,853**	**392,278**	**404,047**	**416,168**	**428,653**

9.3 Balanced Operational Budget

The components of the operational budget (Income, Expenses, and Reserve Funding) are discussed in Sections 9.2 and 9.4, and therefore not repeated here. The complete budget may be found in Appendix 10.14.

9.4 Dedicated Water System Reserve Accounts

Reserve budgets are shown in Table 9-5 based on calculations made in 2020 prior to the pandemic and inflationary surge. Note that emergency reserves are designed to allow it to fund growth to be tied to inflation rate while short-lived replacement reserves are set to meet anticipated needs. The goal of capital reserve (long-term asset) is to make all waterline replacements from cash on hand after two decades.

Table 9-5: Reserve Account Estimates

Reserve	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Operating Reserve										
Beginning Balance	$ 58,252	$ 60,000	$ 61,800	$ 63,654	$ 65,564	$ 67,531	$ 69,556	$ 71,643	$ 73,792	$ 76,006
Contribution	$ 1,748	$ 1,800	$ 1,854	$ 1,910	$ 1,967	$ 2,026	$ 2,087	$ 2,149	$ 2,214	$ 2,280
Ending Balance	$ 60,000	$ 61,800	$ 63,654	$ 65,564	$ 67,531	$ 69,556	$ 71,643	$ 73,792	$ 76,006	$ 78,286
Emergency Reserve										
Beginning Balance	$ 97,087	$ 100,000	$ 103,000	$ 106,090	$ 109,273	$ 112,551	$ 115,927	$ 119,405	$ 122,987	$ 126,677
Contribution	$ 2,913	$ 3,000	$ 3,090	$ 3,183	$ 3,278	$ 3,377	$ 3,478	$ 3,582	$ 3,690	$ 3,800
Ending Balance	$ 100,000	$ 103,000	$ 106,090	$ 109,273	$ 112,551	$ 115,927	$ 119,405	$ 122,987	$ 126,677	$ 130,477
Short-term Asset Reserve										
Beginning Balance	$ 244,660	$ 294,660	$ 346,160	$ 399,205	$ 453,842	$ 510,117	$ 568,081	$ 627,783	$ 156,790	$ 220,129
Contribution	$ 50,000	$ 51,500	$ 53,045	$ 54,636	$ 56,275	$ 57,964	$ 59,703	$ 61,494	$ 63,339	$ 65,239
Withdrawal	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 532,487	$ -	$ -
Ending Balance	$ 294,660	$ 346,160	$ 399,205	$ 453,842	$ 510,117	$ 568,081	$ 627,783	$ 156,790	$ 220,129	$ 285,367
Long-term Asset Reserve										
Beginning Balance	$ 350,000	$ 665,789	$ 928,001	$1,278,058	$1,662,824	$2,067,793	$2,493,789	$2,941,663	$3,372,049	$3,851,984
Contribution	$ 315,000	$ 324,450	$ 334,184	$ 344,209	$ 354,535	$ 365,171	$ 376,126	$ 387,410	$ 399,033	$ 411,004
Withdrawal	$ 15,450	$ 84,872	$ 15,298	$ -	$ -	$ -	$ -	$ 39,270	$ 13,048	$ 362,857
Accrued Interest	$ 16,239	$ 22,634	$ 31,172	$ 40,557	$ 50,434	$ 60,824	$ 71,748	$ 82,245	$ 93,951	$ 97,503
Ending Balance	$ 665,789	$ 928,001	$1,278,058	$1,662,824	$2,067,793	$2,493,789	$2,941,663	$3,372,049	$3,851,984	$3,997,634

Actual reserve balances were about $820,000 in FY 2019-2020, about $910,000 in FY 2020-2021 and about $1,000,000 in FY 2021-2022.

In the table above long-term asset reserve contributions were assumed to be from $325,000 to $400,000 per year. At FY 2022-2023 water rates, LLCC Water System is billing annually around $200,000 for long term reserves and will adjust these contributions in the future based on improved estimates of replacement costs and funding alternatives.

9.5 Water Rate Evaluation

9.5.1 Affordability

The per-user financial obligation to the water system is shown for the 10 years from 2021 to 2030. Because of the lack of treatment, solid planning practices, and high density of services relative to waterline, the system is relatively affordable in comparison to many systems in Washington State. The Washington State Department of Health recommends that water rates not exceed 1.5% of median household income. The average rate charged for the system is projected to be around 1% of the median household income for Mason County per 2020 US Census data. The projected water rates did not account for the effects of the pandemic and rapid inflation.

Table 9-6: End User Average Water Rates

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Annual Rate	$ 581.77	$ 598.36	$ 615.45	$ 633.14	$ 651.59	$ 670.58	$ 690.13	$ 710.24	$ 730.94	$ 752.25
Monthly Rate	$ 48.48	$ 49.86	$ 51.29	$ 52.76	$ 54.30	$ 55.88	$ 57.51	$ 59.19	$ 60.91	$ 62.69

Actual base water rates, including reserves, for a full metered lot were $35 in FY 2020-2021, $50 in FY 2021-22 and $54 in FY 2022-2023.

9.5.2 Rates in Support of Water Use Efficiency

The current rate structure is a tiered structure with increasing usage fees for each tier of usage. The structure provides for an average use of approximately 200 gallons per day under the base rate. The increasing cost per gallon for tiers above the base amount encourage customers to conserve water and provides additional revenue for the system. Implementation of the tiered water rates caused a significant reduction in water use, and therefore a reduction in revenue from the usage tiers, the base rate needed to be further increased to compensate and ensure financial viability for the system.

Chapter 10 Appendices and Supporting Documents

10.1 Site Plans and Hydraulic Analysis
10.2 Emergency Response Plan and Public Notices
10.3 Well Logs and Pumping Equipment
10.4 Booster Pump Curves
10.5 System Inventory
10.6 Meter Data
10.7 Water Facilities Inventory
10.8 Zoning Maps
10.9 Water Rights
10.10 Wellhead Contamination Susceptibility Assessments
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10.14 10-Year Budget
10.15 Consumer Confidence Report
10.16 Sanitary Survey
10.17 Consistency Statements
10.18 SEPA
10.19 SMA Contract
10.20 Construction Standards
10.21 WSP Adoption and General Correspondence
10.22 RH2 Hydraulic Analysis report dated 8/2/21
10.23 RH2 Electrical and SCADA System Evaluation dated August 2021
10.24 LLWS Hydrant Flow Testing results drawing dated July 2022
10.25 RH2 Figure A Estimated Available Fire Flow, Lake Limerick Water System Evaluation with Attachments
10.26 DOH Navy project submission 12.07.22