LAKE FOREST PARK
WATER DISTRICT

GOOD WATER
NATURALLY

(Formerly KCWD83)

COMPREHENSIVE WATER SYSTEM PLAN 2015

August 31, 2016

DANIEL L. MUNDALL
STATE OF WASHINGTON
0032196
REGISTERED
PROFESSIONAL ENGINEER

DATE: **01/ 25 /2018**

MUNDALL ENGINEERING & CONSULTING

PRINCIPAL CONTACTS:

LAKE FOREST PARK WATER DISTRICT

4029 NE 178TH STREET
LAKE FOREST PARK, WA 98155
(206) 365-3211
Website: www.lfpwd.org

DISTRICT COMMISSIONERS

- **BILL DONAHUE**
- **DAVID HAMMOND**
- **ELI ZEHNER**

DISTRICT MANAGER

- **ALAN KERLEY**

LEGAL COUNSEL

- **Richard E. Jonson**
  JONSON AND JONSON
  2701 1st Avenue, Suite 350
  Seattle, WA 98121
  (206) 624-2521

WASHINGTON STATE DEPARTMENT OF HEALTH REGIONAL PLANNER

- **Richard Rodriguez**

PREPARED BY

- **Daniel Mundall, MSCE, PE**
  MUNDALL ENGINEERING & CONSULTING
  P.O. BOX 799
  SUMAS, WA 98295
  (800)-313-9705 CELL (360) 319-1285

TABLE OF CONTENTS

INDEX OF TABLES

INDEX OF FIGURES

INDEX OF APPENDICES

APPENDIX 5 SOURCE PROTECTION PROGRAM

APPENDIX 6 OPERATION AND MAINTENANCE PROGRAM

APPENDIX 7 CONSTRUCTION STANDARDS

APPENDIX 8 CAPITAL IMPROVEMENT PROGRAM

APPENDIX 8 - A MISC DOCUMENTS

APPENDIX 9 FINANCIAL PLAN

APPENDIX 9 - A PIPE LIFESPAN – SUPPORTIVE DOCS

~~APPENDIX 9 - B PENINSULA FINANCIAL RATE REVIEW~~

APPENDIX 9 - C COMMERCIAL ACCOUNT ERU CALCULATIONS FOR CAPITAL IMPROVEMENT FEE

APPENDIX 9 - D SYSTEM DEVELOPMENT CHARGE (SDC) AND GASB-34

APPENDIX 10 PLAN SUPPORT DOCUMENTS

APPENDIX 10 - A WASHINGTON STATE DEPARTMENT OF HEALTH (WSDOH) COMMENTS TO SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - B KING COUNTY COMMENTS TO SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - C CITY OF LAKE FOREST PARK COMMENTS TO SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - D SEATTLE PUBLIC UTILITIES COMMENTS TO LFPWD SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - E NORTHSHORE UTILITY DISTRICT COMMENTS TO LFPWD SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - F NORTH CITY (SHORELINE) WATER DISTRICT COMMENTS TO SYSTEM PLAN DRAFT DATED 12/17/2015 AND LFPWD RESPONSE

APPENDIX 10 - G PUBLIC MEETING RECORD SYSTEM PLAN

APPENDIX 10 - H PLAN SUBMITTAL RECORD

GLOSSARY A - E

ADD – Average Day Demand

ANSI – American National Standards Institute

AWWA – American Water Works Association

BMP – Best Management Practice

CCR – Consumer Confidence Report

CDC – Centers for Disease Control

CIP – Capital Improvement Program

Consumption – The true volume of water used by the system's customers. The volume is measured at each connection to the distribution system.

Connection Charge – A one-time fee paid by a property owner when connecting to the District's system.

CRA – Critical Recharge Area – an area where surface water can easily percolate through soil to recharge underlying aquifer

CPI – Consumer Price Index a measure of the cost of goods that is prepared by the US Department of Labor and is intended as an index of inflation

CPR – Cardio Pulmonary Resuscitation

Cross Connection – A physical arrangement that connects the water system, with anything other than another potable system and therefore presents the potential for contamination

DOH – Washington State Department of Health

Demand – The quantity of water required from a water supply source over a period of time necessary to meet the needs of the system including fire-fighting, system losses and miscellaneous uses. Demands are normally discussed in terms of flow rate, such as million gallons per day or gallons per minute and are described in terms of a volume of water delivered during a certain time period.

EPA – Environmental Protection Agency

ERU (Equivalent Residential Unit) – One ERU represents the amount of water used by one single family residence for a specific water system. The demand of other customer classes can be expressed in terms of ERU's by dividing the demand represented by one ERU.

ERP – Emergency Response Plan

GLOSSARY F - N

FPS – feet per second

Fire Flow – The rate of flow of water required during fire fighting, which is usually expressed in terms of gallons per minute (gpm).

GMA – Growth Management Act

GPM – gallons per minute

HDD – Horizontal Directional Drilling

HDPE – High Density Poly Ethylene a pipe material that is frequently used in municipal piping especially HDD installations.

HGL – Hydraulic Grade Line. The absolute pressure of water measured in feet of a colume of liquid water.

ISO – Insurers Services Office

LFPWD – Lake Forest Park Water District, a public utility serving about 890 customers including about 26% of the area of the City of Lake Forest Park. LFPWD was formerly called KCWD 83.

MG – Million Gallons

MGD – Million Gallons per Day

MCLG – Maximum Contaminant Level Goal. The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a large margin of safety.

MCL – Maximum Contaminant Level**.** The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as is feasible using the best available treatment technology.

MDD – Maximum Day Demand (gallons/day) a projection of maximum water production that is based on historical records. Also known as PDD (Peak Day Demand)

NTU – Nepholometric Turbidity Unit. The unit of measurement for turbidity.

NUD – Northshore Utility District, a public utility serving about 20,000 water customers including about 22% of the City of Lake Forest Park.

NCWD – North City Water District, a public utility serving about 8,000 water customers including about 41% of the area of the City of Lake Forest Park. NCWD was formerly called Shoreline Water District.

GLOSSARY P - R

.

PCE – Personal Consumption Expenditure index, a measure of inflation in Washington State that is comparable to the CPI.

PDD – Demand (gallons/day) a projection of maximum water production that is based on historical records (also known as Maximum Day Demand – MDD)

PDF – Portable Document Format – electronic file format used by Adobe Acrobat™

PHD – Peak Hour Demand, gallons per minute – used to calculate water network capacity

PSI – Pressure, pounds per square inch

PSRC – Puget Sound Regional Council

Parts per million or Milligrams per liter (pp/m or mg/l) – One part per million corresponds to one minute in two years or a single penny in $10,000.

Parts per billion or Micrograms per liter (ppb or μg/l) – One part per billion corresponds to one minute in 2,000 years, or a single penny in $10,000,000.

Piezometric Surface or Elevation a.k.a. Potentiometric Elevation – the elevation to which a column of water will rise from a confined aquifer

Potable – Water suitable for human consumption.

Pressure Zone – A portion of the water system that operates from sources at a common hydraulic elevation.

PRV – Pressure Reducing Valve

PVC – Poly Vinyl Chloride – a pipe material

PWTF – Public Works Trust Fund, a dedicated loan fund administered under Washington Department of Commerce

RCW – Revised Code of Washington.

RMS – Root Mean Square, usually a measure of error in statistical calculations

RTU – Remote Telemetry Unit, a device that connects to sensors or relays and conveys information to/from a central server as part of a SCADA system

GLOSSARY S - Z

SCADA – Supervisory Control and Data Acquisition

SDWA – Safe Drinking Water Act.

SAA – System & Application Associates

SCA – Sanitary Control Area or Sanitary Zone – Typically a 100 foot radius which surrounds a water well. This area is especially critical because direct bacterial contamination can endanger the water supply within this zone.

SPU – Seattle Public Utilities, a public water utility serving about 9% of the area of the City of Lake Forest Park.

Storage – Water that is stored in a reservoir to supplement the supply facilities of a system and provide water supply for emergency conditions.

TBD – To be determined

TCR – Total Coliform Rule established by Washington State Department of Health as a measure of the potability of water

Time of Travel – The time for a drop of water to reach the well head from a given point in the wellhead area.

Unaccounted for Water – Water that is measured supplied to a distribution system but not accounted in water sold or authorized consumption. Usually measured in percent.

WAC – Washington Administrative Code.

Wellhead Protection Area (WHPA) – An area surrounding wells which could impact water quality of the wells. The WHPA contains four zones based on time of travel and the outer boundary may have a buffer zone to account for surface runoff or other factors.

WSDOH – Washington State Department of Health

WSRB – Washington Surveying & Ratings Bureau – an independent organization which carries out fire protection and risk rating functions of ISO (Insurers Services Office) in Washington State.

Zone of Contribution – The catchment area where rainwater could collect and eventually enter an aquifer that is a water source.

INTRODUCTION AND BACKGROUND

(I) INTRODUCTION

This document describes the physical and administrative makeup of Lake Forest Park Water District, hereafter referred to as "the District". Moreover, it outlines plans for needed improvements, and how they can be carried out to fulfill Washington's mandate for "adequate, safe and reliable" water, and continue to fulfill the District's motto of "Good Water – Naturally". This plan replaces the Comprehensive Water System Plan 2005 prepared by Mundall Engineering & Consulting.

From a physical standpoint, the District has changed significantly over the past several years with the addition of the Horizon View wellfield and the SPU-Tolt intertie on 195th Street along with many other supply, transmission and distribution infrastructure. Important administrative changes have also occurred such as management structure and unchanged since previous plans and have been adopted with editing. However, most sections of the document have been entirely re-written.

(II) PLAN OBJECTIVES

A principal objective is to describe history, current status along with 6 year, 10 year and 20 year capital infrastructure and financial plans of the District. While it aims to meet Washington Department of Health (DOH) requirements for Water System Planning, as required by WAC 246-290-100 and WAC 246-291-140, other objectives are equally important to the District. Direct benefits from this process include:

- Summary document for orienting staff, board members, consultants and customers to the most critical aspects of the utility's history, current operations, policies and future goals.
- Documentation for grant and loan applications
- Update of accurate computer based mapping for internal use and for interface with other agencies and utilities.
- Knowledge of existing and future system needs and priorities
- Strategies for complying with the SDWA (Safe Drinking Water Amendment) and other regulatory requirements

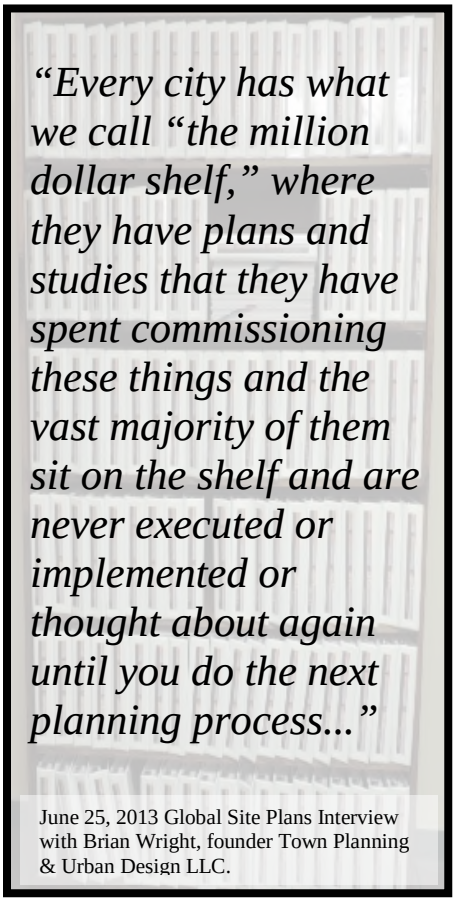
(III) PLAN PREPARATION and FORMAT

This format of this document generally follows the sequential ten-chapter framework suggested in the DOH Water System Planning Handbook. Additional sections have been included as required to meet the objectives of the plan, including a section on *Information Systems* (Part One, Section IX).

Essential information in this plan is conveyed with tables, graphs, forms, drawings and maps in place of narrative where possible. Additionally there is ample use of photographs to better orient and convey information.

Finally, in keeping with the objective of orienting the plan to address internal needs, an emphasis is placed on presenting information that is important to the District. To avoid duplication, and to make the document relevant to the on-going needs of the District, information is adapted from on-going operations and management documents where possible; this is evident in several sections including:

- *Existing System* (Part I) where the current coliform monitoring plan is incorporated.
- *Water Quality and Treatment* (Part III, Section I.3) where the portions of the current Consumer Confidence Report are incorporated.
- *Operations (Part VI)* where some information is correlated directly from in-house procedural document



PART ONE - GENERAL INFORMATION

I. OWNERSHIP AND MANAGEMENT

The District is an independent utility governed under State law RCW 57. The utility is directed by a Board of three elected Commissioners, with four or six year terms. The Commissioners hire a General Manager who is responsible for carrying out policies of the District and directing staff and contractors. Regular board meetings are held on monthly intervals, with special sessions as required. A copy of the current water facilities inventory (WFI) is included in the **Appendix 1-A** for reference. At this time, the District Commissioners are as noted below:

COMMISSIONER BILL DONAHUE

Commission position #3 expires: December 2021
Home Address: 5005 NE 187th St., Lake Forest Park
Home Phone: 206-363-4625
Email: BillDonahue@lfpwd.org

COMMISSIONER DAVID HAMMOND

Commission position #1 expires: December 2017
Home Address: 3015 NE 181st, Lake Forest Park
Home Phone: 206-708-1009
Email: DavidHammond@lfpwd.org

COMMISSIONER ELI ZEHNER

Commission position #2 expires: December 2019
Home Address: 18438 Ballinger Way NE, Lake Forest Park
Home Phone: 425-870-7054
Email: EliZehner@lfpwd.org

NAME CHANGE TO LAKE FOREST PARK WATER DISTRICT

On June 19, 2000 the District formally changed its name to "**Lake Forest Park Water District**". The name change does not in any way reflect a change of ownership or management of the District. The Board of Commissioners voted on the name change to reflect the unique character of the District in relation to its surrounding environment, and to better promote that identity with its customers. Henceforth, any documents reading "King County Water District #83" or "KCWD #83" implies "Lake Forest Park Water District".

General Information

OWNERSHIP AND MANAGEMENT

Origins of the current community water system began with real estate developments by Ole Hanson & Co. in 1910. The Lake Forest Park Water Company, a privately owned water utility, was established in 1926. The utility was purchased by its customers for $50,000 from Lake Forest Park Water Company in 1948.

The District has excellent sources of water and is not in financial, administrative or legal distress, even though it does face major infrastructure improvement costs over the next decade. However, the District management and Commissioners will support other possibilities only if they can guarantee the character and quality of product and service that has come to be expected by its customers as well as cost savings to rate payers. By Washington State law, the City of Lake Forest Park can assume control of the District, if necessary following a vote of the customers of the District. District Commissioners have no evidence that such change would benefit customers, so remain committed to the status quo. In 2013 the District and City of LFP renewed a 5 year franchise agreement for operating in City right-of-way and the District pays the City a 6% franchise fee as part of this agreement.

In 2012 North City Water District (NCWD), which is adjacent to the District, studied the feasibility of a resource pooling agreement with LFPWD and other Districts in the region. Over the past 15 years NCWD has occasionally discussed the feasibility of a combined utility with LFPWD but there remain questions of financial benefit and a guarantee of commitment to independent ground water supply for LFPWD customers.

In the preparation of this plan, the assumption has been carried throughout that there will be no changes in ownership or management that would in any way impact the plans and future development of the District. Any considerations of assumption or merger are separate, undefined, speculative issues and are in no way considered in this plan.

II. BACKGROUND, MISSION AND STRATEGIC PRIORITIES

This section briefly describes the environment in which the District is located and its operation objectives. It includes descriptions of community perspective, physical environment, and relationship to adjacent water purveyors.

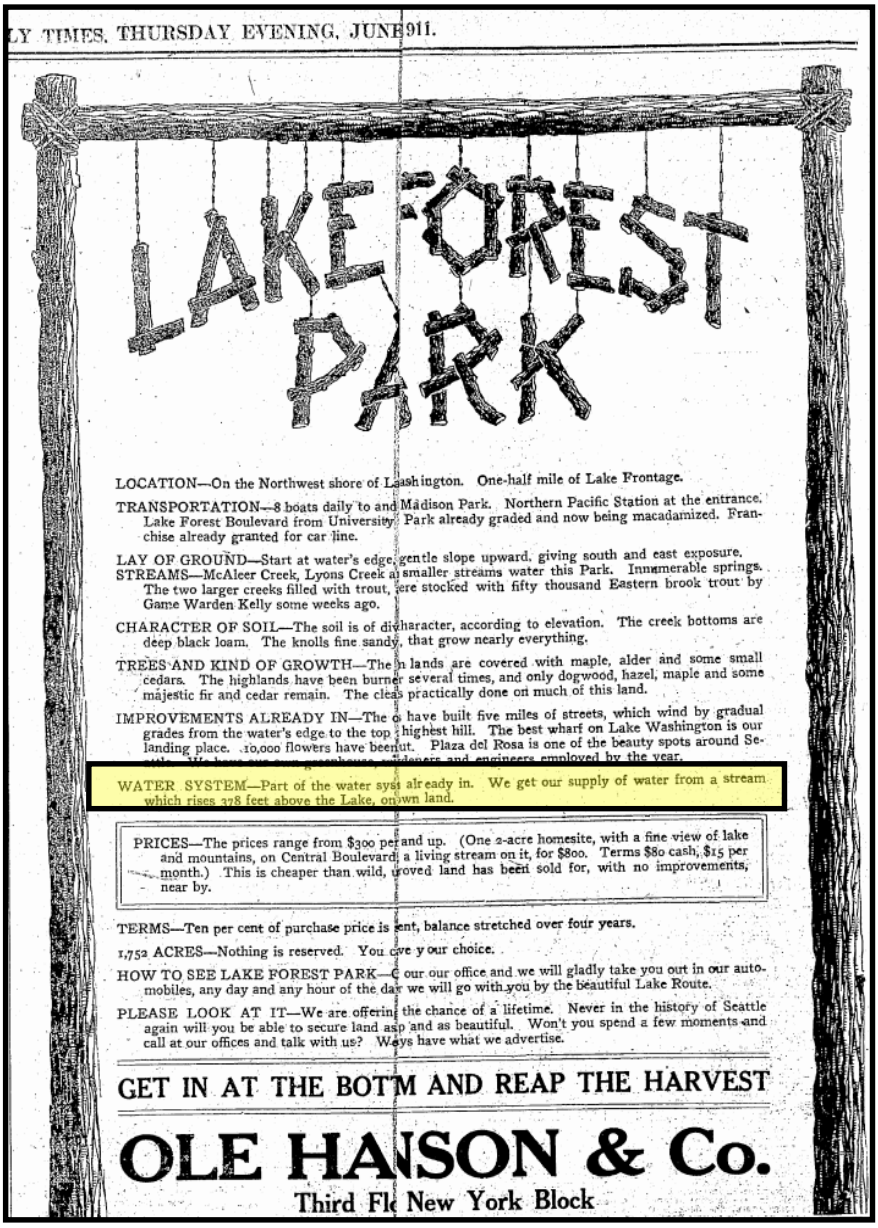
BACKGROUND AND COMMUNITY PERSPECTIVES

The District serves a quiet forested bedroom community within the City of Lake Forest Park, at the north end of Lake Washington.

The earliest vision for "Lake Forest Park" as we know it today was expressed by the real estate developer Ole Hanson who developed Lake Forest Park.

In marketing brochures and newspaper ads of 1910 and 1911 Ole Hanson & Co. expressed a vision for the community as a tranquil "residential park", unpolluted suburban reprieve from the intense urban development of Seattle.

A facsimile sampling of Ole Hanson & Co. ads are reproduced here with emphasis to illustrate the vision which founded Lake Forest Park *and* the primacy of ***"naturally pure water"*** – the banner slogan of the District today.



LY TIMES, THURSDAY EVENING, JUNE 911.

LAKE FOREST PARK

LOCATION—On the Northwest shore of L shington. One-half mile of Lake Frontage.

TRANSPORTATION—8 boats daily to and Madison Park. Northern Pacific Station at the entrance. Lake Forest Boulevard from University Park already graded and now being macadamized. Franchise already granted for car line.

LAY OF GROUND—Start at water's edge, gentle slope upward, giving south and east exposure.

STREAMS—McAleer Creek, Lyons Creek a smaller streams water this Park. Innumerable springs. The two larger creeks filled with trout, ere stocked with fifty thousand Eastern brook trout by Game Warden Kelly some weeks ago.

CHARACTER OF SOIL—The soil is of di haracter, according to elevation. The creek bottoms are deep black loam. The knolls fine sandy, that grow nearly everything.

TREES AND KIND OF GROWTH—The n lands are covered with maple, alder and some small cedars. The highlands have been burne several times, and only dogwood, hazel, maple and some majestic fir and cedar remain. The clea practically done on much of this land.

IMPROVEMENTS ALREADY IN—The o have built five miles of streets, which wind by gradual grades from the water's edge to the top highest hill. The best wharf on Lake Washington is our landing place. 10,000 flowers have been ut. Plaza del Rosa is one of the beauty spots around Se- [illegible] gardeners and engineers employed by the year.

WATER SYSTEM—Part of the water syst already in. We get our supply of water from a stream which rises 378 feet above the Lake, on own land.

PRICES—The prices range from $300 per and up. (One 2-acre homesite, with a fine view of lake and mountains, on Central Boulevard, a living stream on it, for $800. Terms $80 cash, $15 per month.) This is cheaper than wild, roved land has been sold for, with no improvements, near by.

TERMS—Ten per cent of purchase price is ent, balance stretched over four years.

1,752 ACRES—Nothing is reserved. You ve y our choice.

HOW TO SEE LAKE FOREST PARK—C our our office and we will gladly take you out in our automobiles, any day and any hour of the da we will go with you by the beautiful Lake Route.

PLEASE LOOK AT IT—We are offerin the chance of a lifetime. Never in the history of Seattle again will you be able to secure land as and as beautiful. Won't you spend a few moments and call at our offices and talk with us? W ys have what we advertise.

GET IN AT THE BOTM AND REAP THE HARVEST

OLE HANSON & Co.

Third Fl New York Block

Eight decades later the City of Lake Forest Park Comprehensive Plan continued to extend the early vision for the community:

It was conceived as a unique residential community in 1909…

Lake Forest Park always has prided itself on its fundamental character as a community of single family residences…

Lake Forest Park gives one the feeling of tranquility and peace that a park engenders.

Most of the community is supplied with water from a water district serving just our area. The water quality is remarkably pure and the aquifer seemingly inexhaustible. The aquifer is the area of large residential lots and undeveloped lots to the north of the City.

There is a significant history of citizen involvement in our community…

Our residents are also noted for being environmentally sensitive…

Lake Forest Park has generally kept its property levies under those of King County. We feel that we have carefully managed tax dollars to provide better police protection, better road maintenance and better service than can be provided by….

Lake Forest Park seeks to live in harmony with its neighbors. We are not eager for growth for its own sake. The City is also amenable to dialogues about contracting for certain municipal services without necessarily becoming part of the political identity of Lake Forest Park.

"…wishes to remain a small, incorporated municipality whose city officials are known to most residents on a first name basis…

"How can I live in the country and work in the city?"

Lake Forest Park Is the Answer!

NEW HOME OF W. A. REITH NOW BEING ERECTED ON OUR 5000 ACREAGE.

AT LAKE FOREST PARK you can have city telephones, electric lights, pure water from a gravity water system, free wood for the cutting of it, daily deliveries from the stores, a good graded school for your children, a whole acre or more of rich land for vegetables, fruits, flowers and shrubbery, AND —we've saved the best point till the last—YOU CAN RIDE TO TOWN IN COMFORTABLE AUTO STAGES OVER A FINE PAVED BOULEVARD, IN EXACTLY HALF AN HOUR.

Your Choice of 300 Level Acres

$500 an Acre

A Country Home as Big as 10 City Lots

$10 Cash---$7.50 Monthly

—If you want alder bottom land for gardening, we have it.
—If you want a tract with a running trout stream, and cool, crystal springs, we have it.
—If you want an inspiring view tract, adaptable to artistic landscape gardening, we have it.
—If you want virgin forest land with beautiful firs, cedars, dogwoods, maples and shrubbery, we have it also.
—Any kind of land you desire is here.

FREE EXCURSIONS EVERY DAY

Come to our offices and we will take you out to see the land in our auto.

If you are employed, we can take you out after work.

Never again can you secure such value for your money in beautiful country homesites, ON THIS SIDE OF THE LAKE, close to the city.

A. H. REID & CO.

Third Floor New York Block, Second and Cherry.
Elliott 3928.

Excerpts taken from Lake Forest Park Comprehensive Plan, 1994, Section II "A Vision for Lake Forest Park" – adapted from "Identity of a Community", by R. Morrissey, dated 1991

General Information

The District, or its predecessor, has supplied water to the Lake Forest Park community since 1910. The present service boundary has changed little since the 1940's when there was significant suburban residential development. There has only been incremental growth in the last several decades, and that has been entirely through in-filling of existing developed lots. Additional historical information can be found in **Appendix 1-B**

Table 1-1 (following page) summarizes major physical and administrative developments in the system in the last century beginning with the early development of the community by Ole Hanson & related companies. Over this period the system has opted to remain independent from purchased water and has continued to develop its own artesian and deep well sources. To improve reliability of supply, the District has improved its own water storage, while at the same time improving emergency interconnections with adjacent systems.

General Information

MISSION

The following mission statement was adopted by the District Commissioners in 2013:

Lake Forest Park Water District strives to provide high quality water, sourced from our local aquifer, at the lowest reasonable cost, while investing in our infrastructure and maintaining the highest level of customer service.

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY

STRATEGIC PRIORITIES

Financial stability is a high priority as the District copes with major infrastructure improvements over the next 10 years. Steel water mains installed throughout the system in the late 1940's and 1950's are now experiencing increased failure per foot of installed pipe. Fortunately the total footage of these aging pipes is being reduced through replacements each year so repair costs for the system have remained steady at around $22,000 per year. Replacing all remaining steel pipe will cost approximately $3 million based on the cost of recent projects.

Water quality will always be a priority. LFPWD continues to live by its motto "Good Water – Naturally" while also complying with State and Federal requirements for water quality. From informal customer feedback, there is strong support for chlorine-free, chemical-free, naturally pure ground water, and it remains a cornerstone feature of the District's identity with customers and residents in neighboring areas. LFPWD is one of a handful of Class A water systems in the Seattle area that continues to depend on their own ground water supplies rather than sourcing treated surface water from the regional purveyors (Seattle and Cascade Water Alliance.)

The District works diligently to maintain compliance with WSDOH coliform bacteria standards without using residual disinfection. In view of this the District has implemented several special measures to safeguard its water including:

- standby disinfection capacity to rapidly respond to emergency bacterial events without requiring full time chlorination.
- additional non-mandated in-house sampling and bacterial analysis to give advance warning of events
- major upgrades to supply and storage systems to improve integrity against contamination and improve mixing.

General Information

- annual line flushing
- new, state of the art constant flow sampling stations throughout the system to minimize sample errors.
- vigilant safeguarding of wellhead source areas where needed.
- increased sampling above normal required
- development of a backup well-field (Horizon View)
- customer education

LFPWD In-house Analysis Lab

DECADE	PHYSICAL EVENT		ADMINISTRATIVE EVENT
	McKinnon (East Watershed) springs used/ gravity fed system		
		1909	Ole Hanson/North Seattle Improvement Company buy and name Lake Forest Park
1910	Lake Forest Park occupants served by springs	1910	Intial Platting of LFP
	Ole Hanson & Co. run mains from springs	1911-1912	Platting of LFP First Addition
	Ole Hanson & Co. make contracts for water service	1912	Ole Hanson Sales Brochure 'Streams and Springs to be Protected...These as well as the beautiful bubbling hillside springs, will be protected from defilement and destruction.'
	Tanks installed into East Watershed at old springs prior to KC Franchise	1913	Ole Hanson & Co sells water 'plant' to North Seattle Improvement Company's Lake Forest Light, Water and Power for $1000
		1913	Initial Franchise Agreement with King County Sections 3 and 10 to provide a water system to 'build up and promote Lake Forest Park'
1913	Major Houses Built in Lake Forest Park		
1913	Storage Tank #1 Built, 20,000 gallon, 22' diameter, 8' high		
		1914	North Seattle Improvement Company assumes interest in Ole Hanson & Co
			LFP School Opens In Ole Hanson's Sales Building
			Puget Sound Power & Light Service
1915	Supply water to LFP 2nd Addition due to urgent need		First Telephone Service
1915-1916	Water Rights documents reference East Wellfield		
1916	Booster Pump 1 & 2, Booster Tank 1 & 2, Storage tank 4 & 5 installation.		
1917	Storage Tank No 2 completed, 20,000 gallon wood stave, 22' diameter, 8' high		
	Storage Tank West End 3,500 gallon wood stave tank, 10' diameter, 6/' 4" high, 14' high frame tower		
1920			
1920	Storage Tank No 3, 20,000 gallon wood stave, 22' diameter, 8' high completed		
1923	Facilities are now 5 storage tanks of 80,000 gallons, two booster pumps into elevated wooden tank of 2,000 gallons. 133 services for domestic water and irrigation on property owned by North Seattle Improvement Company. NSIC also holding property with springs in LFP Second Addition acquired from Hamlin.		
	First Water meters installed to regulate water use.		
1924	19,956 Lineal feet of Main and 10,044 lineal feet of secondary mains.Flow from springs is approximately 200,000 gallons a day.		
		1925	Lake Forest Power, Water and Light Co gains possession of Watershed land and facilities
			Acquisition of the replat of Lots 13-25 in Block 9, Lots 14-19, inclusive, of Block 13, First Addition which springs and storage tanks are located. And the south 20 feet of Lot 1, Block 1.
1927	Wood stave reservoir and steel water main extension replaced and installed	1927	WA State Department of Public Works suggest to acquire all land where springs seep and develop springs in west end in Block 32 as well.
		1927	Incorporation of Lake Forest Water Company. It purchases land, water source and structures from Lake Forest Light, Water and Power as well as street lighting.
		1927	Deed from North Seattle Improvement Company to Lake Forest Park Water Company that all deeds on land will stipulate that buildings on land will endeavor to build as to 'guard all streams running past or thru the property that the water will remain sweet and pure and fit for drinking water purposes...'
		1927	LFP Water Company Officers are Frank Cooper, Dwight Ware, Richard Bushell, NP Myhre
		1927	LFP Water Company Officers are Frank Cooper, WA Chilcott,NE Mallahan, NP Myhre
		1928	Customer requests the 'West' tank on his property be removed.
		1929	LFP Water Company Officers are MB Jackson, Mr. Chilcott, FT Smith, Robert Rossman
1930	Connections at old Tank updated		LFP Water Compnay Officers are MB Jackson, Richard Bushell, Ed Raymond, RR Rossman
1931	New Foundations under Tanks at Old Springs	1931	
1932	Agreement to Furnish water from Springs to Puget Mill Company property (Sheridan Beach)		LFP Water Company Officers are Mr. Ware, Mr. Chilcott, Mr Campbell, and Mr. Fisher
	Drilling of 4 test wells and build of Wood Stave Tank in Creek Bed		
1935	Replacement of Tanks, betterment of collecting system, installation of four new wells in old watershed		
1937	Pump, Piping and Wiring installation in pump house		
1938	Two sources of water, East Springs or Old springs and West Watershed		
1940	Replacement of old wood pipe, new well drilled in east watershed, 50,000 gallons a day, state testing reveals exceptionally good water.		
	New Well #1 drilled		
1941	Purchase of additional property in East Watershed		
1942	Purchase of additional property in East Watershed		
1944	Replacement of Pump and motors in East Watershed pumphouse		
		1948	
1950		1948	King County Water District #83 chartered
		1952	Commissioners John Oakley, Clarence Nogler, AL Perry
		1953	Commissioners Herb Metke, Clarence Nogler, AL Perry
1953	East watershed supply from shallow wells 24 feet deep from which water is siphoned and one deep well.	1954	Commissioners Herb Metke, Clarence Nogler, WS Farsje
		1954	KCWD 83 buys LFP Water Co for $50,000, Election held to offer up to in $140,000 Revenue Bonds, $120,0000 were approved by Commissioners
		1954	Board to contract with Heath, Hammond & Collier as District Engineer
		1955	Commissioners Herb Metke, John Oakley, WS Farsje
1955	40th Pl & 45th Pl mains installed 6" steel	1958	Commissioners Herb Metke, John Oakley, Jim Rogers
	Water System Improvement LID #1		
1958	New deep well drilled and put into use		Begin discussion on use of Reserve property within East watershed
1960		1961	
1960-67	Wells 1,2 & 3 drilled and placed in service	1960-67	Commissioners Herb Metke, John Oakley, Charles Moran
		1961	Ground water rights for Wells 1,2 &3 at McKinnon Cr. Watershed
		1961	WA State Department of Conservation's Artesian Warer Supply Bulletin identifies KCWD 83 artesian wells in Bulletin 16 as source in an emergency without power
		1961	FD#16 buys 1/2 of property on NE 178th
1963	Water System Improvement LID #2		
	Water System Improvments to Beach Zone, NE 178th and NE 180th, WHPA, NE 182nd, NE 185th, West Watershed, 50,000 Gallon Tank		
1963	KCWD to supply water to Shopping Center		
1963	200,000 gal steel standpipe for high zone installed	1964	
1964	Completed Construction of steel tank to serve higher elevation		Superintendent Hedblom retires & Superintendent Chalmers is hired

Table 1-1 Timeline of Significant Developments In District

DECADE	PHYSICAL EVENT		ADMINISTRATIVE EVENT
			Commissioners Herb Metke, Jim Rogers, EF Raymond
		1964	
		1965	Towne Center Opens, contract with Seattle Water Department service
1965	West watershed discontinued	1966	Commissioners Herb Metke, Jim Rogers, MH McArthur
1966		1967	West watershed sold
1967	240,000 gal steel reservoir for low zone installed		Commissioners Herb Metke, MH McArthur, Dr Charles Evans
		1970-71	
1970	Water System Improvements Benders Evergreen Estates Div #2		Purchase of Lange Reserve property, 700 customers
1970	Work on 184th to reroute creek to protect exposed water main.	1971	
	Main Replacement 40th Between Ballinger and 182nd	1973	Investigation of constructing a backup connection to Tolt near SPU reservoir
		1973	Comprehensive Plan by HCW-L (August)
			Commissioners Herb Metke, MH McArthur, William Currie
1974	Well #4 completed		
	PRV 178th to 180th		
1977	Construction of Pump House East Watershed	1977	
	Water System Improvements NE 180th and 52nd Pl NE		Commissioners MH McArthur, William Currie, Dr. Gordon Hungar
1980			
1983	Water System Improvements 33 Ave NE and 190th		
		1984	Sale of 3 lots (2 in watershed)
1984	Main Replacement 47th and 184th		Comprehensive Plan by HCW-L (March)
1986	184th "Canyon" main replacement with 12" D.I.		Intertie Agreement with Northeast Lake WA Sewer and Water
	180th main extension	1986	
	Six siphon wells online		
	Well #4 drilled - McKinnon Cr. Wellfield		
1987	WHPA Improvments	1987	
	NorthEast Sewer and Water Inter Tie		
1988	Water Main Improvments Ballinger Way East of 35th	1988	WD #83 selle water to NE Lake WA Sewer and Water
1990	PWTF '89-90 Watermain replacement program - approx. 10,400 ft	1991	Commissioners William Currie, Dr. Gordon Hungar, Tim Davis
		1992	WD #83 Supplies drinking water to Towne Center Mall
1992-98	installed sample stands		Superintendent Chalmer retires, Manager Lay is hired
1993	District offices bought & installed at 4029 NE 178th		
1994	Pump installed in well 4; master meter installed	1998-99	
1994	Watermain replacement program - approx 5,800 ft	1998	SWD proposes merger
1995	12 inch pipe in watershed completion		Interlocal Agreement with Shoreline WD for mutual aid
1998	Standby Chlorination installed, new ultramag master meter	1999	
			Manager Lay leaves, Superintendent Sexton is hired
2000		2000	Upgrade to billing system
2002	Standby tank installed 12,500 gal HDPE		Change name to Lake Forest Park Water District
	McKinnon Cr. WHPA piping improvements	2003	
2003	182nd Street W. of 30th main replacement 8" DI 700 ft		Develop web site - LFPWD.ORG
	McKinnon Cr. WHPA: Interior/Exterior Coat Low Res + New Inlet		
	McKinnon Cr. WHPA: DW1, 2 Pumps replaced	2003	
			Agreement signed Dec 4, 2003 with King County for Brightwater treated effluent tunnel
2004	Beach Dr. 17200 Block rmain replacement 2" HDPE		
2005	185th 30th Ave to 35th Ave main replacement 8" DI		
	Last remaining Wood stave tank dismantled		
	45th PL between 40th Pl and 46th Ave. main replacement 8" DI		
	51st PL main replacement 8" DI and 2" HDPE		
	80kw Standby Generator Purchased/Installed for backup to pumps		
	SCADA system at McKinnon Cr. WHPA for data logging pump, well, reservoirs		
2006	80kw diesel Standby Generator operational	2006	
2007	40th PL. Developer Extension - Highberger (Upright Construction)	2007	Comprehensive Plan 2005 prepared by Mundall Engineering approved by WSDOH
2007	New continuous flow sample stations purchased from Seattle and installed		Mediation begins with King County over refusal to construct backup wells per agreement
2008	180th + Lakeview Lane 10" DI + 2" HDPE		
2008	Shore Place 2" HDPE watermain replacement	2008	
		2008	Mediation with King County concludes, $2,000,000 settlement to construct wells
		2008	5 year Franchise agreement with City of Lake Forest Park (ORD #979)
		2008	Mediation with KC concludes: $2 million settlement to build backup wells; KC to build intertie with Tolt
		2008	Commissioner Dr. Gordon Hungar sudden death, Commissioner Dr. Julie Hungar appointed
2009	187th PL - 8" DI and 2" HDPE before City paving project	2009	Commissioners William Currie, Tim Davis, Julie Hungar
			Purchase #18460 47th PL for District pumping facility $215,000
2009	Drill Horizon View wells #1,2 on SPU property to prove source		
2009	Construction of SPU Intertie Phase I - SPU Tolt intertie and 10" DI on 195th and 8" DI on 46th Ave.		
2009	Refurbish High Zone standpipe reservoir, install mixing manifold		
2009	18310-18350 47th Pl NE 8" DI, 2" HDPE		
2010	182nd Street E., of 30th Ave. main replacement 8" DI to 178th St.	2010	
2010	10" HDPE, DI South WHPA to 43rd Ave + 8" DI/PRV on 185th and 40th Ave to 188th PRV		District begins in-house water sample analysis for bacteria redundant to State required goal to improve coliform detection capacity.
2010	Construction of SPU Intertie Phase II - HDD 10" HDPE to McKinnon Cr. WHPA		
2011	Ballinger Way main replacement b/t 184th and 178th - 12" DI 1580ft		Fraud investigation - Office Administrator
		2011	
2011	Brightwater tunnel boring under LFP aquifer at 195th St.	2011	F. Alan Kerley appointed as General Manager
2011	Horizon View Wellfield Phase I - Access Rd., 8" W/M from Horizon View wellfield to 46th Ave. + 10" PRV SPU intertie water on 46th Ave.	2011	
		2011	50 year Emergency Intertie Agreement with Seattle Public Utilities (SPU)
		2011	Commissioner William Currie retires, sudden death of Commissioner Tim Davis
		2011	Commissioner Bill Donahue appointed by King County
		2011	Commissioner David Hammond appointed by Hungar and Donahue, Dr. Julie Hungar retires. Commissioner Eli Zehner appointed.
2012	Horizon View Wellfield - Phase II - Reservoir, well pumps, control building and site work.	2012	Purchase 2ac Horizon View wellfield property from SPU for $200,000 plus adm. exp.
		2012	Application to Washington Dept. Ecology for water rights withdrawal changes - add withdrawal locations for existing wells to create wellfield.
		2013	
2013	Ribbon cutting Horizon View Well project		
			5 year Franchise agreement with City of Lake Forest Park renewed by default
2013	Ballinger Way PRV at 175th		
2013	LFP Towne Center - 10" DI Dev. Ext. north driveway		
		2014	Water rights changes approved to aggregate withdrawal between all sources
			Comprehensive Plan 2014 prepared by Mundall Engineering DRAFT

ENVIRONMENT - TOPOGRAPHY AND GEOLOGY

The topographical and geological characteristics of the service area are important as they determine the location and capacity of water mains, storage reservoirs and booster pump stations. **Figure 1-1** is a location map of the District. The District lies at the north end of Lake Washington and is bordered on the north and east by Northshore Utility District (NUD) and on the south and west by North City Water District (NCWD).

(a) Topography

Figure 1-2 and **Figure 1-3** offer a shaded relief and contour map of the District. Elevations in the District service area vary from a low of 21 feet at the south border along Lake Washington, to a high of over 400 feet at the northern boundary near 46th Ave. and along 187th St. The terrain rises gradually toward the north along Ballinger Way with steep slopes to both the west and east of Ballinger Way, the more pronounced being the rise to the northeast corner of the District.

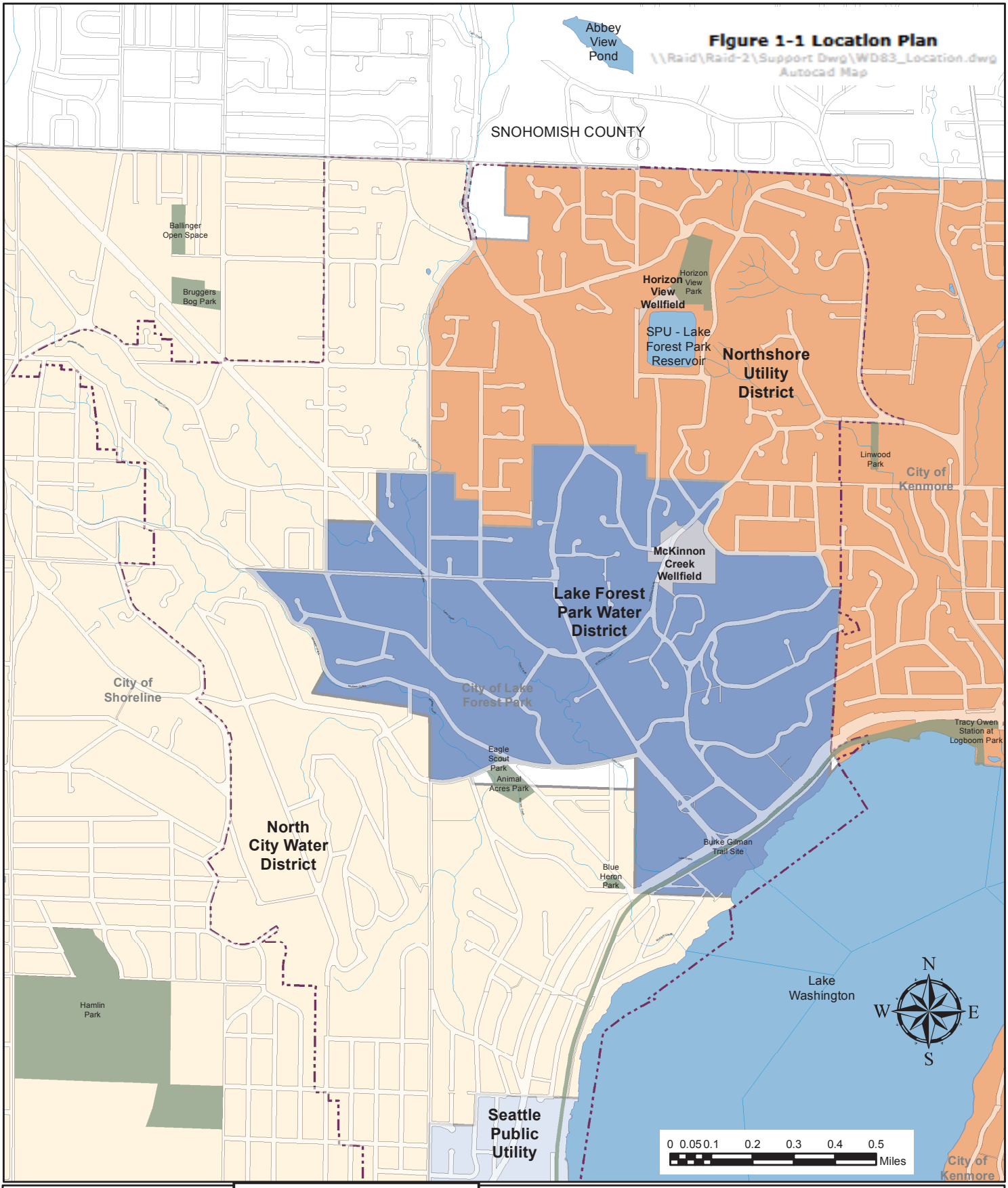
The topography of the District's service area has historically required four pressure zones, *High, Intermediate, Low*, and *Beach* in order to keep service pressures in a reasonable range. This system was engineered over 6 decades ago, and reported in 1965 in a comprehensive plan for the District developed by HCWL. The pressure zones described in this plan are similar although a new pressure zone has recently been created by the Horizon View reservoir. The *Horizon View* zone permits service to customers in elevated areas, including those that are now being served by adjacent utilities.

(b) Geology

Figure 1-4 describes the geological zones observed in the District. This information is adapted from the geological survey presented in the 1973 and 1984 comprehensive plans by HCW-L. Well driller logs for the District water wells offer additional geological profile information. These physical characteristics are discussed further in Part Five of this plan (Source Protection).

Additional geological information has become available in recent years through the investigations related to the King County Brightwater conveyance tunnel project. The District is now in possession of drilling bore logs and hydrogeological information from these investigations. Please see the report entitled: Summary of Lake Forest Park Hydrogeologic Investigations Geotechnical Services for the Brightwater Conveyance System, June 20, 2005 Contract No. E23007E, Task 163 {**Appendix 1-C** contains a copy of the District agreement with King County.}

The District plans to conduct additional investigation of surface geology in an area of Brier, near Abbeyview pond and northward to better identify the Critical Recharge Area (CRA) for the LFP aquifer. Further discussion is presented in Part Five.



LAKE FOREST PARK WATER DISTRICT

FIGURE 1-1

LOCATION MAP

POLITICAL BOUNDARIES AND ADJACENT WATER DISTRICTS

Legend

City
- Lake Forest Park
- Park

Water District
- Seattle Public Utility
- Northshore Utility District
- North City Water District
- Lake Forest Park Water District

- Right of Way
- Water Course
- Water Body
- Wellfields

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

MUNDALL ENGINEERING & CONSULTING

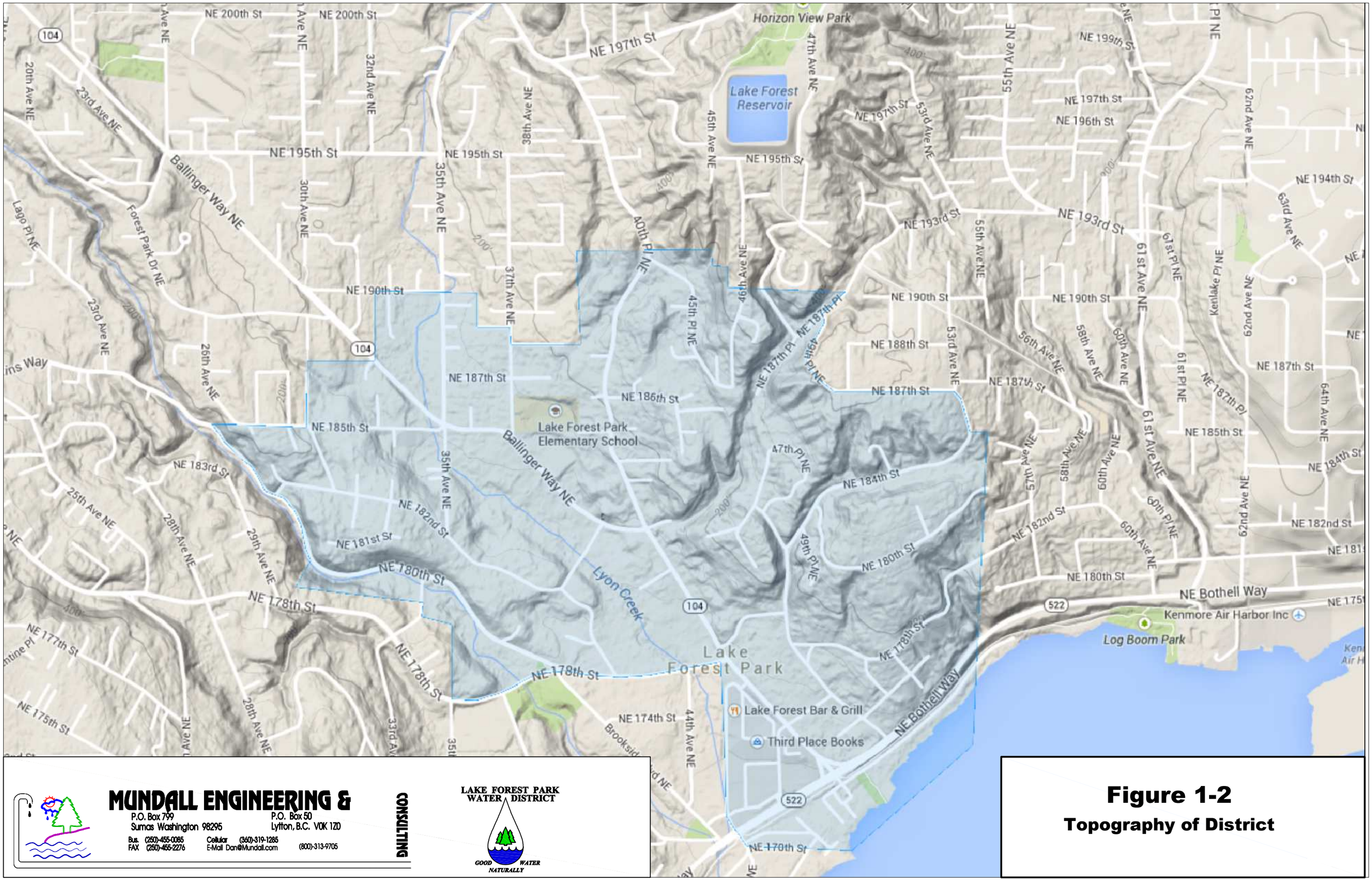
P.O. Box 799
Sumas, Washington 98295

P.O. Box 50
Lytton, B.C. V0K 1Z0

Toll Free
1-800-313-9705

Bus. (250)-455-0085
FAX (250)-455-2276

Cellular (360)-319-1285
E-Mail Dan@Mundall.com



MUNDALL ENGINEERING & CONSULTING

P.O. Box 799
Sumas Washington 98295

P.O. Box 50
Lytton, B.C. V0K 1Z0

Bus. (250)-455-0085
FAX (250)-455-2276

Cellular (360)-319-1285
E-Mail Dan@Mundall.com

(800)-313-9705

LAKE FOREST PARK WATER DISTRICT

GOOD WATER NATURALLY

Figure 1-2

Topography of District

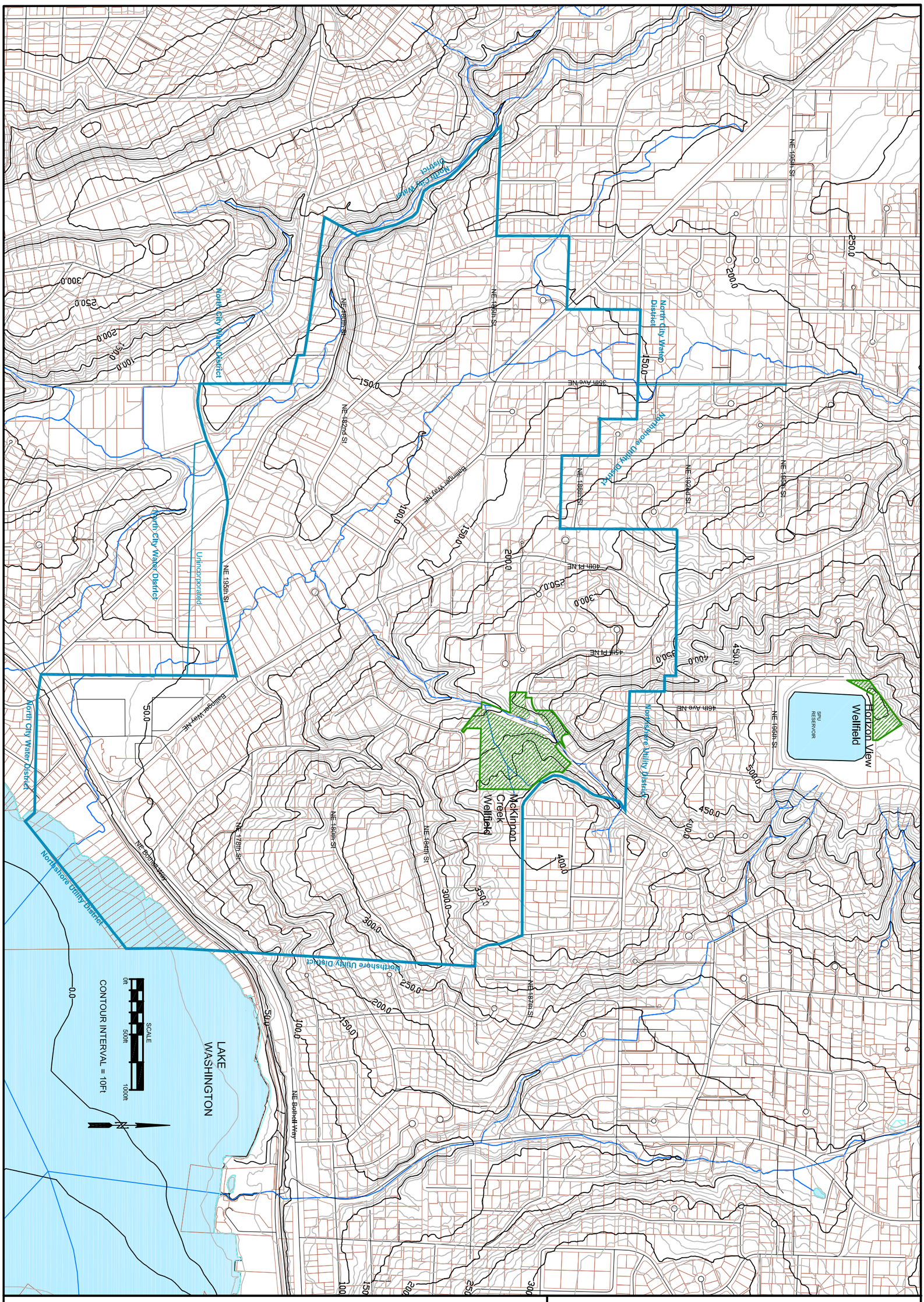


FIGURE **1-3**

CONTOUR MAP AND DISTRICT BOUNDARY

February, 2015 - (Contours extracted from KCGIS Datum)

LAKE FOREST PARK WATER DISTRICT

GOOD WATER NATURALLY

MUNDALL ENGINEERING & CONSULTING

P.O. Box 799 Sumas Washington 98295
Bus. (250)-455-0085 FAX (250)-455-2276

P.O. Box 50 Lytton, B.C. V0K 1Z0
Cellular (360)-319-1285 E-Mail Don@Mundall.com (800)-313-9705

SURFICIAL GEOLOGY

Lake Forest Park Water District

Summary: Regional surface geology was largely shaped by the most recent glaciation period, the Vashon Stade. During this glaciation the approximately 3000 ft thick Puget lobe of the Cordilleran ice sheet eroded, compacted, and transported material. As the glacier advanced and then receded, the hydraulic actions resulted in soil types which can be characterized by examining their composition. This map describes the predominate surface soil types in and around Lake Forest Park Water District.

Mapping and descriptions of geological formations extracted from USGS map "Geologic Map of the Edmonds East and Part of the Edmonds West Quadrangles, Washingon" by James P. Minard 1983

Figure 1-4

Map Key

- **Qvt** — Vashon Till - Uppermost and most extensive unit in the region. Mixture of clay, silt, sand, pebbles, cobbles and boulders. Often referred to as 'hardpan', it is heavily compacted from glaciacion. Poorly draining. Maintains vertical slopes. 2-15m
- **Qvr** — Recessional Outwash - From receding Vashon glacier. Mostly stratified sand and gravel with minor silt and clay. Stable.
- **Qva** — Advance Outwash - Mostly clean, gray, pebbly sand with gravel. Underlies the till (Qvt)
- **Qyal** — Younger Alluvium - Poorly drained fluvial sediments along streams, around Lake Washington. Mostly sand and gravel with organic rich mud. 1-5m
- **Qoal** — Older Alluvium - Stratified sand and gravel with some organic rich silt. 1-5m
- **Qtb** — Transitional Beds - (Fraser Glaciation) Beneath Vashon Advance (Qva), consists of gray clay, silt, fine to very fine sand, some layers of peaty sand and gravel. Unstable steep slope. 10-20m
- **Qls** — Landslide Deposits - Clay, silt, sand, and gravel. Blocks of material to intermixed debris. Still active with movement after above-average rainfall.
- Lake Forest Park Water District Boundary
- Lake Forest Park Water District Wellfields

MUNDALL ENGINEERING &
P.O. Box 799
Sumas Washington 98295
Bus. (360)-855-0393
FAX (360)-855-2276
P.O. Box 50
Lytton, B.C. V0K 1Z0
Cellular (360)-319-1286
E-MAIL DonMundall@aol.com
(800)-313-9705
CONSULTING

LAKE FOREST PARK WATER DISTRICT
GOOD WATER NATURALLY

III. DESCRIPTION OF EXISTING SYSTEM

This section is intended as basic system background information on the capacities and general operation of the system and is adapted from District sources. More detailed information on the network can be found in Part Three of this document.

SYSTEM INFORMATION

LAKE FOREST PARK WATER DISTRICT
Public Water System ID #40950K
4029 N. E. 178th ST.
Lake Forest Park, WA. 98155

SOURCES:

D.O.H. SOURCE NUMBER	SOURCE NAME/ID	WELL DEPTH	INTERTIE ID
S01	McKinnon Cr. Well #1 AFJ001	216 ft.	
S02	McKinnon Cr. Well #2 AFJ002	190 ft.	
S03	McKinnon Cr. Well #3 AFJ003	161 ft.	
S04	Northshore Intertie		40800 5
S05	McKinnon Cr. 8 artesian wells	22 ft. Average	
S06	McKinnon Cr. Wellfield wells 1,2,3	varies	
S07	Generic water well		
S08	Seattle Emergency Intertie from Tolt pipeline on 195th St.	N/A	77050 Y
S09	Horizon View Well Field wells 1,2	N/A	
S10	Horizon View BAM 416 (well #1)	465 ft	
S11	Horizon View BAM 417 (well #2)	465 ft	

STORAGE:

Name	*Nominal Capacity*	*Construction.*	*Pressure Zone*
Lower Reservoir	240,000 gallon	steel tank	Low (294ft HGL)
Standby Tank	12,000 gallon	HDPE tank	Low (294ft HGL)
Stand Pipe	200,000 gallon	steel tank	High (452ft HGL)
Horizon Eq. Tank	50,000 gallon	steel tank	Horizon (569 HGL) Note: datum NAVD88 for all reservoirs

TREATMENT:

There is no treatment at this time. Standby chlorination was implemented in early 1999 to respond in the event of samples reporting positive in the distribution system.

PRESSURE REDUCING STATIONS:

#	*Pressure Zones*	*Location*	*Elevation, ft (NAVD88)*
1.	SPU Tolt→Horizon View	46th Ave. at 195th St.	506 ft
2.	Horizon View→High	187th St. at 46th Ave	308 ft
3.	High → Intermediate	3844 NE 185th	165 ft
4.	High → Low	5084 NE 178th	250 ft
5.	Intermediate→ Low	3036 NE 182nd	140 ft
6.	Low → Beach	Ballinger Way NE and 175th St.	50 ft

PRESSURE ZONES:

Figure 1-5 is a profile of water flow through the system from source to distribution. All of the McKinnon Creek well sources feed directly into the lower reservoir, while Horizon View water feeds in to the High zone standpipe. The system is made up of five pressure zones, with a maximum HGL as follows:

1. **Horizon View (569ft)**
   Note: The 50,000 gal equalizing tank at the Horizon View wellfield serves the Horizon View zone which is also supported by the Seattle intertie PRV set at HGL 560 ft.
2. **High (452ft)** A 200,000 gal steel stand pipe serves the High and Intermediate pressure zones and is normally filled by means of a pump station supplied by the lower reservoir. In addition to the primary source, water can also cascade into the High zone from Horizon View/SPU Intertie at HGL 448 and from Northshore Utility District at HGL 426ft.
3. **Intermediate (342ft)** flows from the High zone through a PRV to the intermediate zone.
4. **Low (294ft)** is supplied directly from a 250,000 gal reservoir and there are additional pressure reducing valves which connect to the High and Intermediate pressure zones.
5. **Beach (232ft)** is supplied by PRV from the Low zone.

There are also three closed valves between the pressure zones:

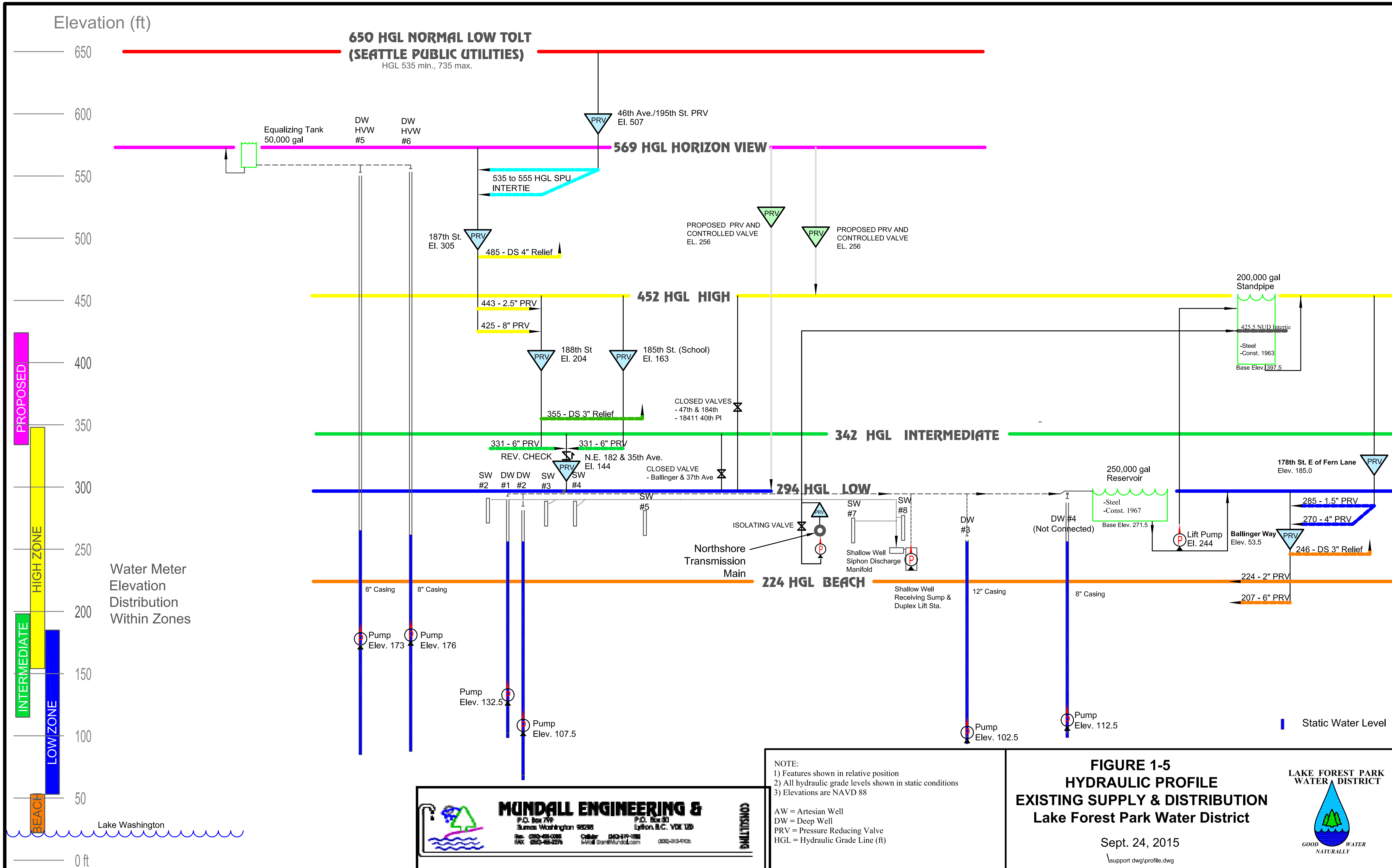
- 18443 40th Place NE
- 37th Ave. and Ballinger Way NE
- 47th Avenue NE at 184th Street

INTERTIES:

The District has two emergency interties with neighboring water utilities:

1. **Emergency Intertie with Seattle Public Utilities** – is located on the South shoulder of 195th Street near 47th Ave. and receives water from the Tolt pipeline. Hydraulic analysis shows this intertie could provide up to 2,000 gpm to the District and is triggered when line pressure from Horizon View wellfield drops below HGL 560 ft. The District has a 50 year emergency intertie agreement with Seattle for this intertie which allows up to 3,500 gpm for a week for fire or other emergencies.

2. **Intertie with Northshore Utility District (NUD)** - is located in a vault in the District's wellhead production area and consists of two 250 gpm pumps for transferring water to NUD and conversely a pressure sensing valve which will open at a set drop in pressure to transfer water from NUD to the LFPWD high zone. This intertie has a demonstrated capacity of 500gpm. The District has an interlocal agreement with NUD for this intertie.



Elevation (ft)
650
600
550
500
450
400
350
300
250
200
150
100
50
0 ft
PROPOSED
HIGH ZONE
INTERMEDIATE
LOW ZONE
BEACH
Lake Washington
Water Meter Elevation Distribution Within Zones
650 HGL NORMAL LOW TOLT (SEATTLE PUBLIC UTILITIES)
HGL 535 min., 735 max.
46th Ave./195th St. PRV El. 507
Equalizing Tank 50,000 gal
DW HVW #5
DW HVW #6
569 HGL HORIZON VIEW
535 to 555 HGL SPU INTERTIE
187th St. El. 305
485 - DS 4" Relief
PROPOSED PRV AND CONTROLLED VALVE EL. 256
PROPOSED PRV AND CONTROLLED VALVE EL. 256
452 HGL HIGH
443 - 2.5" PRV
425 - 8" PRV
188th St El. 204
185th St. (School) El. 163
200,000 gal Standpipe
425.5 NUD Intertie
-Steel -Const. 1963
Base Elev. 397.5
CLOSED VALVES - 47th & 184th - 18411 40th Pl
355 - DS 3" Relief
342 HGL INTERMEDIATE
331 - 6" PRV
331 - 6" PRV
REV. CHECK
N.E. 182 & 35th Ave. El. 144
CLOSED VALVE - Ballinger & 37th Ave
SW #2
DW #1
DW #2
SW #3
SW #4
SW #5
294 HGL LOW
250,000 gal Reservoir
-Steel -Const. 1967
Base Elev. 271.5
178th St. E of Fern Lane Elev. 185.0
285 - 1.5" PRV
270 - 4" PRV
ISOLATING VALVE
SW #7
SW #8
DW #3
DW #4 (Not Connected)
Lift Pump El. 244
Ballinger Way Elev. 53.5
246 - DS 3" Relief
Northshore Transmission Main
Shallow Well Siphon Discharge Manifold
224 HGL BEACH
Shallow Well Receiving Sump & Duplex Lift Sta.
224 - 2" PRV
207 - 6" PRV
8" Casing
8" Casing
12" Casing
8" Casing
Pump Elev. 173
Pump Elev. 176
Pump Elev. 132.5
Pump Elev. 107.5
Pump Elev. 102.5
Pump Elev. 112.5
Static Water Level
PRV
MUNDALL ENGINEERING & CONSULTING

NOTE:
1) Features shown in relative position
2) All hydraulic grade levels shown in static conditions
3) Elevations are NAVD 88

AW = Artesian Well
DW = Deep Well
PRV = Pressure Reducing Valve
HGL = Hydraulic Grade Line (ft)

FIGURE 1-5
HYDRAULIC PROFILE
EXISTING SUPPLY & DISTRIBUTION
Lake Forest Park Water District

Sept. 24, 2015

\support dwg\profile.dwg

LAKE FOREST PARK WATER DISTRICT
GOOD WATER NATURALLY

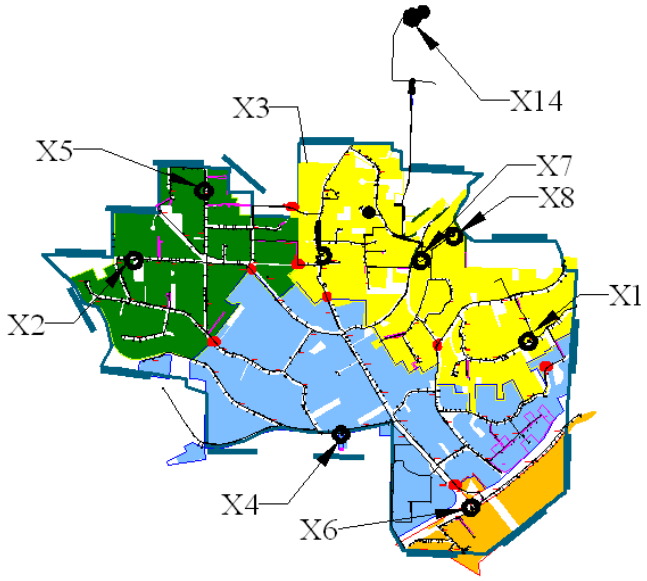
POPULATION AND CONNECTIONS BY PRESSURE ZONE

SERVICE CONNECTIONS	*HGL*	**CONNECTIONS*	***AVG. HOUSEHOLD*	****POPULATION*
HORIZON VIEW PRESSURE ZONE	573	0		
HIGH PRESSURE ZONE	449 ft	307	2.554	779
INTERMEDIATE PRESSURE ZONE	338 ft	249	2.554	633
LOW PRESSURE ZONE	292 ft	264	2.554	667
BEACH PRESSURE ZONE	228 ft	79	2.554	204
TOTAL SERVICE CONNECTIONS		**899**		**2,283**

*Connection count based on service meter count and differs from customer count
**Average Household size taken from US Census, 2010 Blockgroup #530330215003
***Population estimates do not distinguish commercial accounts

Table 1-2 Connections by Pressure Zone in 2013
Data from District Sources

SAMPLING STATIONS		
H	X1	18005 53rd Ave. N.E.
I	X2	3021 N.E. 185th St.
H	X3	4004 N.E. 185th St.
L	X4	4029 N.E. 178th St.
H	X5	18903 35th Ave. N.E.
B	X6	17301 Beach Dr. N.E.
L	X7	Low Tank (Low Zone)
H	X8	High Tank (High Zone)
S	X9	McKinnon Cr. DW1
S	X10	McKinnon Cr. DW2
S	X11	McKinnon Cr. DW3
S	X12	McKinnon Cr. DW4
S	X13	McKinnon Cr. SW Res.
S	X14	Horizon View Tank
S	X15	Horizon View DW1
S	X16	Horizon View DW2



LAB: Edge Analytical (360) 757-1400 main
(800) 755-9295

SAMPLING REQUIRED BY STATE REGULATION: 3 samples per month.
Note: State required samples taken on first week of each month.
ALL SAMPLES: Presence/Absence (PA) method.
No routine samples taken from X7 or X8

ROTATION:
Schedule of rotation for engineering samples
Use this schedule if there are 4 weeks in month. Use this schedule if there are 5 weeks in month.

II. Order	Sample Site
Week 1	X8,X1,X2
Week 2	X8,X3,X4
Week 3	X8,X5,X6
Week 4	X7,X3,X4

Order	Sample Site
Week 1	X8,X1,X2
Week 2	X8,X3,X4
Week 3	X8,X5,X6
Week 4	X7,X3,X4
Week 5	X8,X5,X6

Repeat sample sites are available upstream and downstream of all sample sites. The 6 distribution system sample sites are located in the extremes of the system.

All sources can be sampled directly as necessary.

III. ROUTINE & REPEAT SAMPLE SITE ADDRESSES

HIGH PRESSURE ZONE	SITE ADDRESS
X1 - Routine Sample Site	18026-53rd Ave. N.E.
- Repeat Upstream	18035-53rd Ave. N.E.
- Repeat Downstream	5318 N.E. 180th St.
X3 - Routine Sample Site	4004 N.E. 185th St.
- Repeat Upstream	4001 N.E. 185th St.
- Repeat Downstream	18476-40th Pl. N.E.
X5 - Routine Sample Site	18903-35th Ave. N.E.
- Repeat Upstream	18727-35th Ave. N.E.
- Repeat Downstream	3417- N.E.190th St.
INTERMEDIATE ZONE	
X2 - Routine Sample Site	3021 N.E. 185th St.
- Repeat Upstream	3211 N.E. 185th St.
- Repeat Downstream	3021 N.E. 185th. St.
LOW ZONE	
X4 - Routine Sample Site	4029 N. E. 178th St.
- Repeat Upstream	4036 N. E. 178th St.
- Repeat Downstream	4004 N. E. 178th St.
BEACH ZONE	
X6 - Routine Sample Site	17301 Beach Dr. N.E.
- Repeat Upstream	17228 Beach Dr. N.E.
- Repeat Downstream	17337 Beach Dr. N.E.

IV. RELATED PLANS

Several plans have been reviewed as they relate to this system. **Table 1-3** below summarizes some observations and potential conflicts with these plans:

Ref.	*REFERENCE PLAN*	*COMMENTS*
1	***NUD* Comprehensive System Plan June 2015** P3-14 "*The District had previously served certain customers within LFPWD; however, the District's service area boundary was revised to include these customers*." P4-15 Table 4-6 "Other purveyor zone"	LFPWD is not aware of any changes to corporate boundaries. There are boundary overlaps that need to be resolved with an interlocal service area agreement. There has been no boundary adjustment or annexation done and King County Boundary Review records indicate these customers are within LFPWD service area. District also needs to pursue an agreement regarding confidentially of customer information shared between NUD and LFPWD for NUD sewer billing. 452 ft "High" pressure zone
2	***North City(Shoreline) Water District Comprehensive Water System Plan 2011***	
3	***Lake Forest Park Sensitive Areas Prepared for City of Lake Forest Park By King County Environmental Division***	City of LFP Ordinance 930- Deviations allowed from the best available science. "C. Utilities that are granted more lenient treatment under some circumstances because they provide significant community benefit in themselves and the community benefits from efficient and economic installation of utility facilities."
4	***Lake Forest Park – Comprehensive Plan –*** DRAFT 2015	Northshore Boundary does not reflect NUD sewer customers inside LFPWD boundary
5	***East King County Coordinated Water System Plan***	
6	***Seattle Public Utilities – Water Supply Plan*** In addition to the above, the City of Edmonds and Lake Forest Park Water District have emergency intertie contracts with SPU covering all types of emergencies.	LFPWD concurs with this description regarding emergency interties

Table 1-3 Comments from Related System Plans

Data from District Sources – Edited in Microsoft Word

V. EXISTING AND FUTURE SERVICE AREA

Figure 1-6 illustrates the District's existing and future, corporate service area. As defined by DOH, the "Existing Service Area" is the area where the utility currently provides service. Service is presently provided to all parcels shown with a hatching pattern.

Future Service Area is defined by DOH as the area in which a purveyor intends to provide water service. For the District, this is defined by the official corporate boundary recognized by the Boundary Review Board. (thick grey border on **Figure 1-6**)

There are fragmented sections where service has been provided in the interim by adjacent districts, both NUD and NCWD, but are inside the District's corporate service area. **Table 1-4** summarizes the number of legal parcels serviced within the District boundaries, both by the District, and by NUD and NCWD. For additional information please see documents in Part Ten which list individual properties within the corporate boundary that are currently served by others.

Pressure Zone	*Served by LFPWD inside formal boundary*	*Served by NUD inside District's boundary*	*Served by NCWD inside formal boundary*	*Served by LFPWD outside formal boundary*
Horizon View	0	44		
High	304	1		3
Intermediate	249	5	11	
Low	260	0	10	4
Beach	67			12
Totals	**880**	**50**	**21**	**19**

Table 1-4 Existing Accounts Inside Future Service Area in 2014

Data from District Sources – Edited in Microsoft Word

Formal service boundaries were originally established in the mid 1900's. Several higher areas in the north part of the District were withdrawn from the District boundaries. These reduced the corporate service boundary to the present form in 1948.

Figure 1-7 shows existing zoning within the District. The District is contained entirely within the City of Lake Forest Park and is near saturation development. Nearly all of the 1038 legal parcels in the District are zoned Single Family Residential. Of this approximately 953 (92%) are developed and 66 (6.3%) are vacant and un-developed at present. In addition there are approximately 9 commercial and 10 parks/recreation or institutional parcels.

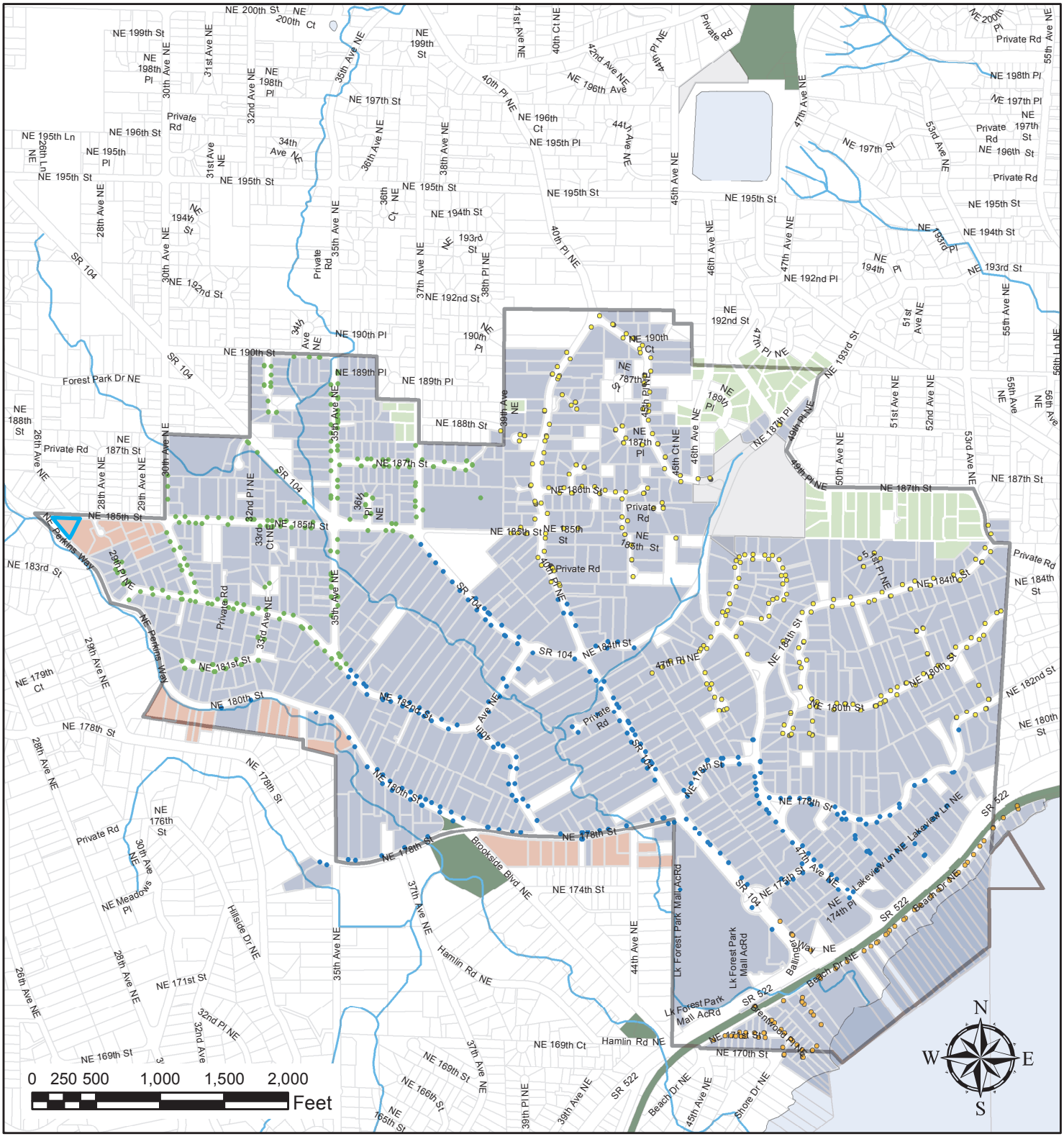


Figure 1-6 Water Service Areas

Parcels served by LFPWD, parcels within the corporate boundary temporarily served by others, and parcels that are currently unincorporated.

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

Legend

Street

Meters

ZONE

- Beach
- High
- Int
- Low

Parcels

Servicing Water District

- NCWD
- LFPWD
- NUD
- Undeveloped or N/A

Boundary

- LFPWD Corporate
- Wellfields
- Park

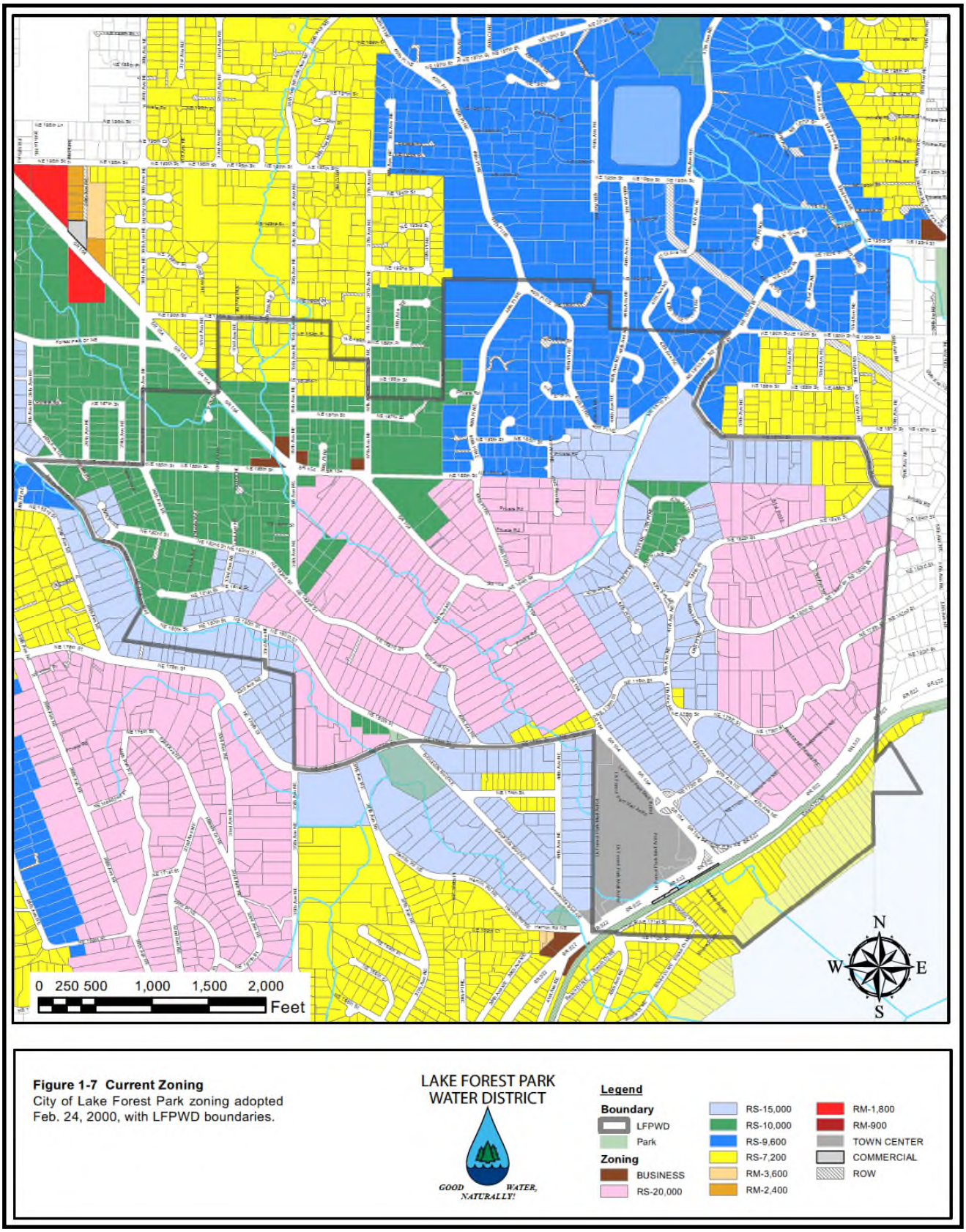


Figure 1-7 Current Zoning
City of Lake Forest Park zoning adopted Feb. 24, 2000, with LFPWD boundaries.

Figure 1-7 Current Zoning

Raid2\Support Dwg\LFP_Current_Zoning.PDF

VI. AGREEMENTS

SERVICE AREA AGREEMENTS

Presently there are no service area agreements in place with neighboring utilities for customers served across District boundaries. An effort is underway to resolve this issue between the District and NCWD. A total of 71 customers are served by adjacent utilities within the District's corporate boundaries, and four customers within NCWD boundaries are presently served by the District.

OTHER AGREEMENTS

Other agreements are in place with the following entities as described below:

Entity	*Type*	*Scope*	*Term*
King County Department of Transportation Road Services Division	Mutual Aid	Equipment assistance with operator for road restoration, mowing, hazardous waste response and material handling	**12/17/1997 until revoked**
Northshore Utility District	Mutual Aid	General maintenance duties as required Emergency Response	**11/25/1997 until revoked**
North City Water District (aka Shoreline Water District)	Mutual Aid	General maintenance duties as required Emergency Response	**7/24/1998 until revoked**
City of Lake Forest Park	Mutual Aid	Assist with operations and maintenance tasks	**Not determined**
City of Lake Forest Park	*Franchise	Authorizes operation of water distribution within City Right-of-Way. District pays 6% fee.	**9/8/2008 renew every 5 years until revoked. (Next renewal 9/8/2018)**
Northshore Utility District	Intertie	Emergency water supply or demand	**5/18/1987 until revoked.**
Seattle Public Utilities	*Intertie	Emergency water supply	**7/7/2011 to 7/7/2061 (50 years)**
King County – Waste Water Treatment Division	*Special	Brightwater conveyance tunnel	**12/3/2003 indefinite**
Dept. of Commerce – Public Works Board	Loan	*PWTF PW-5-94-784-022* (1994 Main replacement)	**4/28/1994 to 7/1/2014**
Dept. of Commerce – Public Works Board	Loan	PWTF PW-01-691-034 (Intermediate Zone Repl. & Upgrades 2001)	**5/42001 to 7/1/2021**
Dept. of Commerce – Public Works Board	Loan	PWTF PC08-951-022 (Intermed. Zone Imp. Phase IV & V)	**3/1/2008 to 7/1/2026**
Dept. of Commerce – Public Works Board	Loan	*PWTF PC13-961-009* (Source and Supply Imp. in WHPA)	**7/7/2011 to 6/1/2032**
******Various Parties******	Easement	Water/Utilities conveyance	Indefinite terms

*Refer to **Appendix 1-C** for full text of these agreements

Table 1-5 District Agreements

CROSS-CONNECTION CONTROL

The District maintains and enforces a cross connection control program. There are presently 132 connections requiring backflow prevention valves and other devices that are tracked in this system. All records are maintained on a computer database for tracking compliance status. A complete copy of program policies and status is included in **Appendix 1-D** for reference including:

- Cross connection survey form sent to customers in the District
- Summary of site address for backflow prevention assemblies
- Compliance letters 1,2,3 sent to owners annually as required

VII. REQUIREMENTS FOR SERVICE CONNECTION

NEW SERVICE APPLICATION FOR WATER AVAILABILITY

All applicants within the service boundaries are offered service pending verification of water availability (i.e. pressure, flow). Individual or group request for service is initiated by the land owner/developer by submitting an application for water availability which is available from the District. The District Manager or Engineer then reviews the application and states the terms of water availability. In some cases the owner/developer may be required to commit to a water system improvement such as a new fire hydrant or main extension. The complete application process takes 2-3 weeks on average. At the present time there is sufficient water rights capacity for saturation development of all 1038 lots in the District to current zoning standards (See Figure 1-7) so water rights capacity is not considered for routine water service applications. Water rights capacity would be reviewed in the event of a large commercial, institutional or multi-family development requiring re-zone. In the event of a dispute involving a new service or developer extension the proponent or his representative is invited to meet directly with the District Board of Commissioners to present his position. The District does not have a policy of limiting or committing to a time interval in a water service availability application.

CAPACITY AND DEMAND PLANNING

New development of single family dwellings in the District is marginal and nearing saturation. District water supply needs are assessed system wide using population projections from PRSC (Puget Sound Regional Council) with adjustment for customer boundary corrections. Capacity and Demand Planning is covered in Part II while Water Rights are covered in Part IV of this document.

There are incremented connection charges for new services, based on expected flow. Total connection charges for a new service include a "buy in" fee and construction cost for the connection as shown below:

Meter Size	Meter Equivalent (ERU)	"Buy-in" Charge	Construction Charge	TOTAL
5/8"x3/4"	1	$2,105.63	$3,600.00	$5,705.63
1"	1.5	$3,158.45	$3,600.00	$6,758.45
1.5"	2.5	$5,264.08	ACTUAL	TBD

*ERU = Equivalent Residential Unit

See **Appendix 1-E** for a copy of the District's New Connection application form, and Connection Charges Table.

VIII. USER COMPLAINT POLICY

User complaints are logged by District staff, or recorded in 24-hour voice messaging. Emergency calls are forwarded to the responsible District staff's pager. Response to call in complaints is by telephone, within 24 hours. Written copies of complaints are maintained in file by District staff.

Table 1-6 summarizes customer complaint activity that has been logged over the last 17 years. Most complaints have been related to general customer service issues rather than water quality or delivery issues. A more detailed discussion of the District's handling of customer complaints appears in Part Six.

CUSTOMER COMPLAINT ACTIVITY 1996 - 2014

Year	Water taste/color	High bill	Leak	Misapplied payment	Never received bill	Construction Related	Miscellaneous	Total per year	Adjusted - Complaints per 1000 hookups per year	Column	Column
1996		2	2	7			5	16	19.0		
1997	1	4	2	5	3		18	33	39.1		
1998	1	3	2	2	3		10	21	24.7		
1999			4	5	4		8	21	24.7		
2000	3	34	3	3	5		4	52	61.1		
2001	2	20	5	2	11	17	12	69	81.2		
2002	3	24	2	1	13	2	6	51	59.6		
2003	5	13	3	3	11	6	9	50	58.3		
2004	1	16	5	2	10	1		35	40.7		
2005	2	15	2	2	5	3		29	33.6		
2006								0	0.0		
2007	1	2	7			1	5	16	18.4		
2008	4	2	8			2		16	18.4		
2009	5		5				1	11	12.6		
2010	4		6			3	2	15	17.2		
2011	7	7	4	2	2	2		24	27.4		
2012	6	8	4	2	3	3		26	29.6		
2013	0	2	1	0	1	0		4	4.5	YTD	
2014	10	8	4	2	3	3		30	34.1		

File: Raid2:\System Plan Work\2015 Comp Plan\Complaints.xls

Table 1-6 Customer Complaint Activity

\\Raid\raid-2\System Plan Work.xls

IX. INFORMATION SYSTEMS

BACKGROUND DISCUSSION ON INFORMATION AND TECHNOLOGY

This section briefly outlines strategic goals, policies and procedures that help to streamline and safeguard a critical resource, information. It is hoped that the basic structure outlined here can be further developed over the planning period. In former decades, information was managed in this District by maintaining customer and administrative records with ledger books and files. Less critical information was conveyed orally through personal contact, and sorted and discarded when no longer relevant or when the manager retired. With increased use of computers, the result is a combination of digital and conventional data production and storage. Over the last 18 years the District has made significant investments in computer software and hardware in an effort to better manage information and increase staff productivity.

CURRENT SYSTEM OVERVIEW

With rapid developments in electronic communication and computing, the District must weigh the benefits and limitations of available technologies, with their associated cost. The elected representatives of the District and staff attempt to weigh the benefits of various new technologies against realities of what it will require in time, user training, increased complexity, and vulnerability to failure.

Five general types of information form the majority of data managed by the District, and are the most crucial to on-going operation and management:

1) Customer billing and metering records.
2) Administrative, employee records, water quality compliance.
3) Geographic, system mapping, and administration.
4) Computer programs, software.
5) Informational, periodicals, newsletters, reports.

Over the last 15 years the District has converted many records to digital media for functionality and archival security. Records that have been converted to digital media at the present time include:

- Paper as-built drawings have been scanned and geographically referenced.
- All Board Resolutions have been scanned and are in searchable PDF.
- Minutes of meetings from the last six decades have been scanned in PDF

Plans are to continue conversion of other administrative data, in order of priority.

CUSTOMER BILLING AND METERING RECORDS

The District began computerized billing in 1993 with a MS-DOS based billing system called WATMON. In 1999 the District began using “Waterware”, now owned by SAA (System & Application Associates). Waterware is built on the Microsoft Access database engine, an industry standard.

General Information

ADMINISTRATIVE RECORDS

Administrative data is maintained in either hard copy or digital media (or both). Detailed lists of both hard copy and digital files appear in **Appendix 1-F**. Most digital administrative data is stored in one of four formats:

1. Microsoft Word (Reports, Correspondence, Agenda) *.DOC, DOCX
2. Microsoft Excel (Voucher Summaries, Calculations, Structure Row/Column Data) *.XLS, XLSX
3. Microsoft Access (Large Data Sets) including customer billing *.MDB
4. Adobe Acrobat (Any documents or drawings) *.PDF

GEOGRAPHIC INFORMATION SYSTEM MAPPING

The District began an ambitious program of GIS development in 1998 using the AutoCad Map environment, now Autodesk "Civil3D". There have been periodic updates to the map over the past 15 years. This is providing the District with the GIS structure needed to support the mapping needs for on-going maintenance and operations, as well as capital improvement projects.

The GIS system is based on State Plane coordinates, consistent with GIS systems used by other major municipal and county entities in the region including the cities of Seattle and Shoreline.

Presently, the District has mapped the following system information, obtained from scanned or imported as-built files, and cut sheet data:

- Parcel boundaries* and legal data relating to each parcel, data base format, attached to graphical file, KCGIS
- District boundaries, based on record information.
- Water mains* – x, y, pipe type, size, elevation, friction coefficient "C" value and age of pipe. Data are managed by the "WaterCAD"^{TM} model database.
- Elevation contours with labeling at two foot intervals, allows detailed evaluation of pressure at any location in the District.
- Service lines, Service Meters*
- Fire hydrants, Main valves.*
- Blow offs, air release/vacuum/backflow.
- Ortho-rectified aerial photograph imagery in tiled geo tiff files, 6 inch pixel, color, 2009 Flights, Pictometry International Corporation, by agreement from King County.
- Pipe failure locations over the last 15 years.
- Pressure zones, with hatching of each parcel, indicating pressure zone.
- Easements on private property including meta data such as easement agreements.
- Reservoirs, pumps and WHPA information

** Item has attached data table and may be linked to corresponding records in database*.

The District is presently porting mapping information into ESRI ARC-GIS environment to provide a more robust environment for distributed data access, GIS query functionality and

publishing. Objectives are to provide a server based mapping environment that can also be used by maintenance staff in the field.

STRATEGIC OBJECTIVES FOR INFORMATION SYSTEM DEVELOPMENT

A proper perception of the emerging technological and market environment is essential to developing strategic objectives for this system plan. Some observations and assumptions that are made here include:

- The District plans to maintain control over its principal geographic and administrative data and is not considering 3rd party solutions for billing or other information services.
- Electronic communication such as internet, e-mail, and facsimiles, are critical components of normal business operations.
- Consumer complaints show a demand for electronic services such as remote review of account history and electronic bill paying. This demand is expected to continue to grow and the District has requested these features in updates for its billing software "Waterware"
- Hardware reliability has been an issue in productivity.
- Geographical mapping information will continue to become more widely utilized and standardized, and the District will increase its capacity to integrate and share GIS data.

In this environment the following strategic goals have been defined for information management in the District:

1) Increase distributed access capabilities for administrative and GIS databases. Presently the following data are accessible through a distributed database:
    - SCADA/Telemetry data *(password controlled access)*
    - Phone call system management *(password controlled access)*
    - Security camera systems *(password controlled access)*
    - Minutes of meetings *(open – www.lfpwd.org)*
    - Forms *(open – www.lfpwd.org*)
    - Policies *(open – www.lfpwd.org)*
    - News/informational *(open – www.lfpwd.org)*
    - Public file server *(open – www.lfpwd.org)*
    - Administrative file directory *(password controlled access)*

    The following database information is considered priority for creating distributed access:
    - Billing portal for customers to view bill and pay by direct debit or credit card. *(user restricted access)*
    - GIS/mapping data including photographs. *(controlled access)*
    - Work orders and reporting *(controlled access)*

    Implementation: by 2020
2) Continue to use industry standard hardware, geo-data and software where possible and insisting on open access to data.
    Implementation: On-going
3) Continue to build information management systems in ways that are compatible with adjacent agencies where practical.
    Implementation: On-going

PART TWO - WATER PRODUCTION AND CONSUMPTION FORECASTS

Accurately projecting population involves many variables including regional economic growth and local development potential. Future water demand is further impacted by customer usage patterns, system leak losses, and service rate policies. For LFPWD the impact of moderate growth in the service population over the past two decades has been offset by customer conservation and leak detection, repairs and pipe replacement and this trend is expected to continue.

I. CUSTOMER BASE AND WATER PRODUCTION TRENDS

This section describes customer count and usage information for the District, and is useful in projecting future water demands, and in determining physical capacity.

HISTORICAL TRENDS

The District is located in a mature residential area characterized by slow growth. Records of active accounts with the District indicate growth typical of a residential community reaching saturation development densities. The customer base has grown by less than 0.5% per year over the last several years.

Figure 2-1 illustrates average and peak (max) day production since 1971. The flow values are recorded at the McKinnon Creek wellfield source master meter, and include leakage as well as authorized uses such as line flushing and hydrant tests.

Peak day demands appear to have declined over past several decades in spite of moderate increase in customers. This may reflect several changes in the system including:

1. Decreased leakage losses resulting from on-going pipe replacement programs.
2. Rate increases which prompt water use reduction
3. Water meter replacements which improve water accounting
4. Water conservation programs – including publicity programs by Seattle
5. Under-reporting turbine type master meter used prior to 1998.
6. Improved pressure regulation. Incorrectly set or failing PRVs feeding the Low Zone have caused backfeed into the Low zone reservoir, causing it to overflow.
7. Fluctuations in climate

Average day water production trends appear to be relatively constant averaging about 0.26 MG/day over the past 10 years.

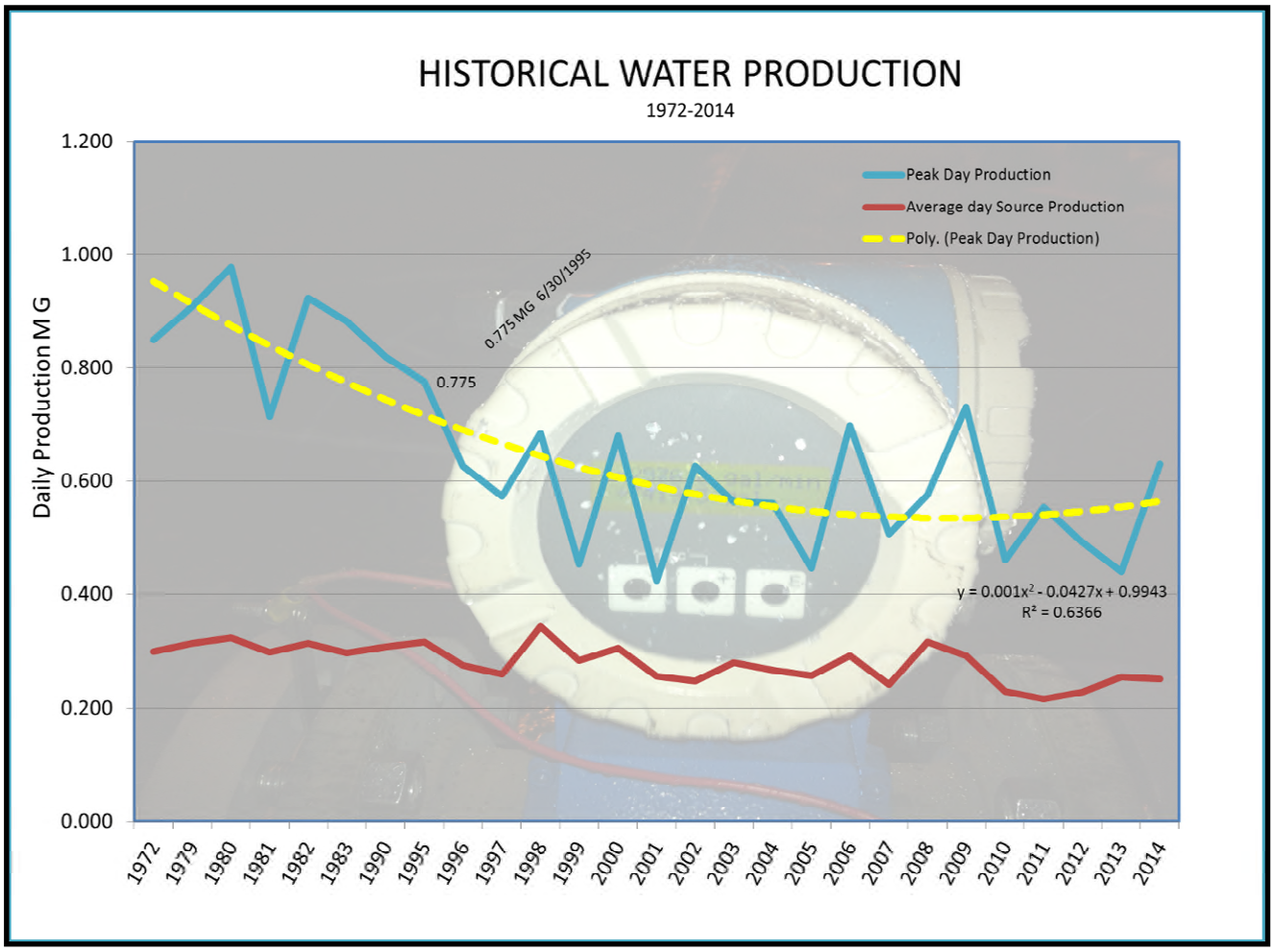


Figure 2-1 Peak Day Production History

\\Raid\raid-2\Water Usage\Water Usage Report.xls – Excel

DISTRIBUTION OF DEMAND IN SYSTEM

Figure 2-2 illustrates historical usage breakdown by pressure zones in the distribution network. These data reflect residential demand only. Demand is almost evenly split between the High, Intermediate, and Low zones, with only 13% from the Beach zone. Presently there are no customers in the Horizon View pressure zone.

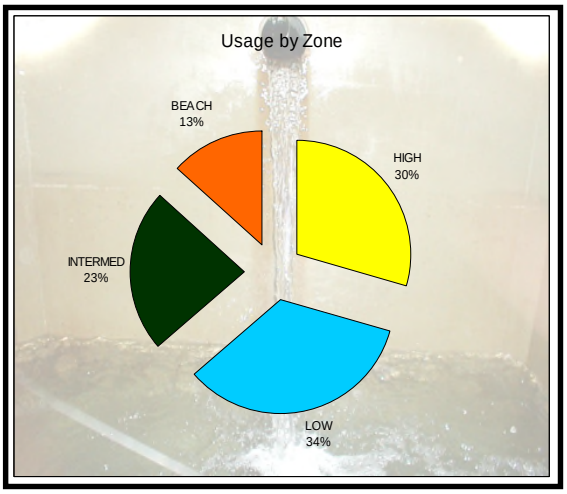


Figure 2-2 Usage by Zone

SEASONAL VARIATIONS

Outdoor watering and seasonal domestic patterns create significant variations in water use although this is consistent with the region and development density.

Figure 2-3 shows average, maximum, and minimum day production for each month at the master meter averaged over 17 years (1995-2012). These data show that peak usage occurs in the months of July and August, when average day flow over a month is over 400,000 gallons per day, nearly double the wet season averages of 215,000 gallons per day. Records taken since 1970 show that annual maximums are most likely to occur between June 20 and August 12.

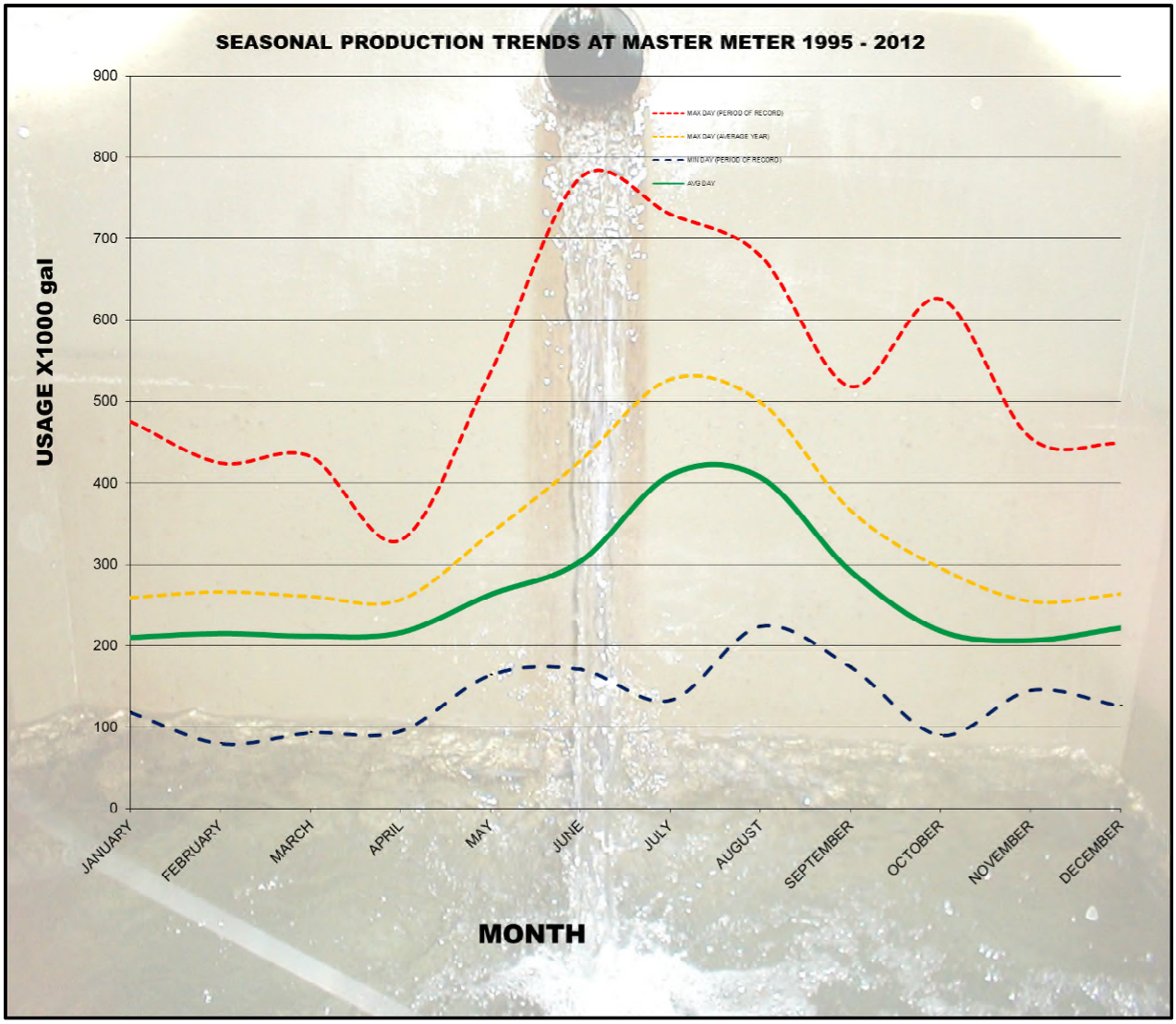


Figure 2-3 Seasonal Production Patterns
\\Raid\raid-2\Water Usage\Water Usage Report.xls

II. PROJECTED POPULATION AND WATER DEMANDS

The District expects only minimal growth of single family dwellings and a moderate increase in multi-family and commercial development over the planning period. Data were taken from US Census 2010 and Population & Employment Forecasts for Central Puget Sound Region, DRAFT, April 2013 which was prepared by the Puget Sound Regional Council (PSRC). PSRC projected population based on census data by Transportation Analysis Zones (TAZ). These were apportioned to the District service area by GIS. Data were further refined by interpolation for continuity.

SERVICE POPULATION AND CONNECTIONS

Future service population is influenced by local development and zoning as well as regional and national economy.

Figure 2-4 shows historical and projected service population within the District's boundaries. Historical and projected household size was obtained from PSRC data and partitioned to the District service boundary. Growth in the District customer base was extrapolated from historical records. The data project a gradual increase in service population and total connections from 2013 through 2033.

There is a small adjustment in customer count in 2013 where accounting procedure was changed in the reckoning of commercial connections.

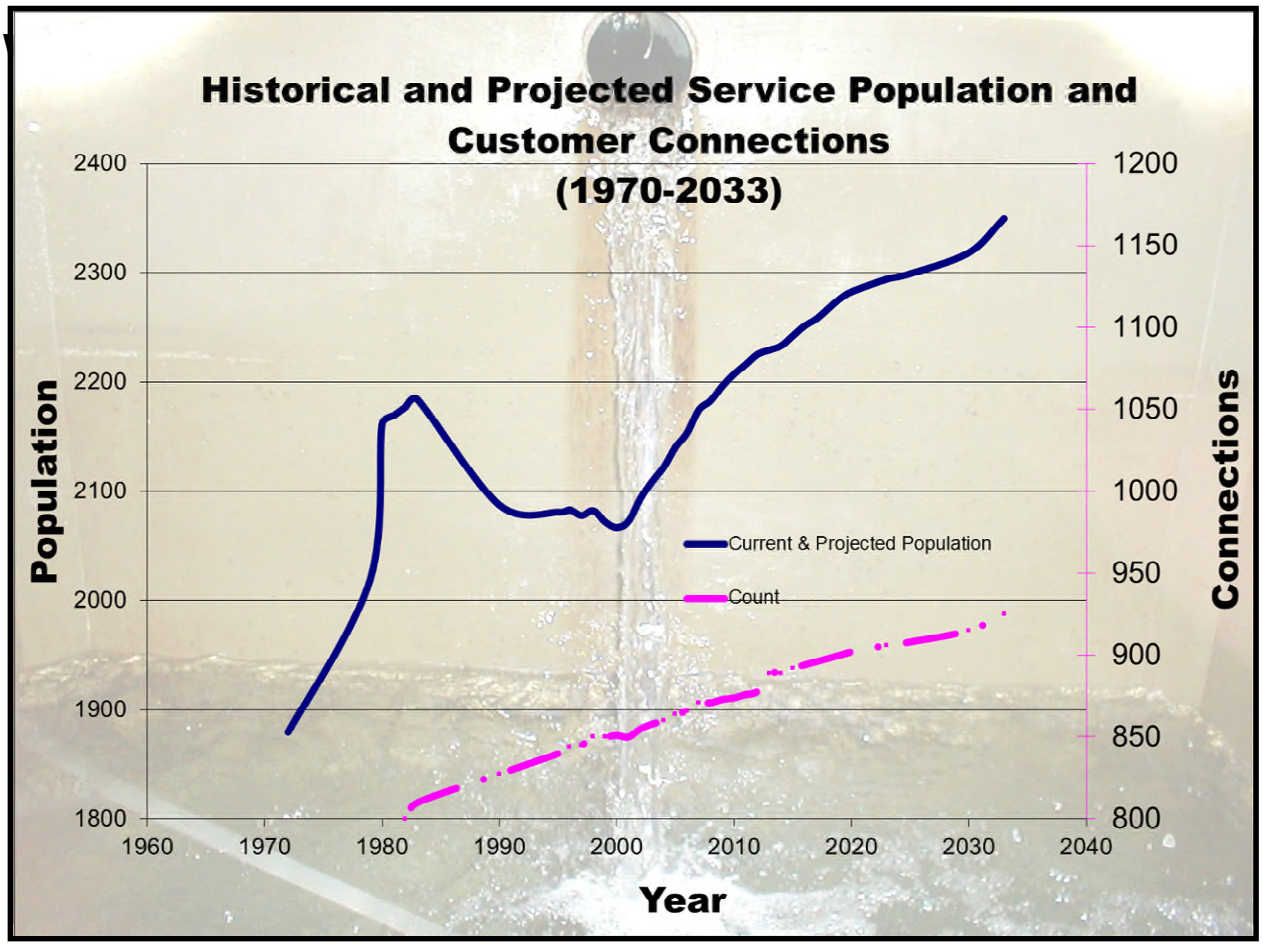


Figure 2-4 Projected Population

\\Raid\raid-2\Water Usage\Water Usage Report.xls

Projected connections do not include the impact of:

- Boundary agreements resulting in adjustments with NUD and NCWD. Up to 71 residential units could be added to the District from these changes. It is estimated that the addition of these lots would increase system demands by approximately 10 percent over current projections. The District hopes to open discussions that would lead to a service boundary agreement with NUD and NCWD over the period of this plan but no change is reflected here.
- LFP Towne Center – possible multi-purpose commercial/multi-family development, up to 300 residential units have been discussed by the previous owner Madison Marquette but nothing definitive has emerged.

Service population decreased from 1983 through the year '2000 even as customer count increased. This is because average household size was reduced over the same period from 2.7 to 2.4 persons per household. These trends are believed to be caused by the demographic of post war baby boomer children maturing and moving away leaving empty nest residences. Census data suggest that household size has increased since '2000 - a trend which may indicate departure of many senior residents while younger couples with children are taking their place. In most cases the family size of these younger residents remains smaller than the previous generation.

Water Use and Demand Forecasts

Table 2-1 is a summary report of historical and projected water usage related data and include the following data from 1972 forward and projecting to 2033:

- Demographic Data (taken from system records and PSRC, US Census)
  - Total Connections
  - Single Family connections
  - Commercial connections
  - Average household size
  - Population served

- Metered Source Production Data (taken from master meter records)
  - Total Annual Production, MG
  - Annual Line flushing Consumption, MG
  - Net Annual Production, MG
  - Average Day Production, MG
  - ERU Count based on production data (average day)
  - Peak (Max) Day Production, MG
  - Peak Day Production per ERU, Gal/day
  - Peak Day Production GPM
  - Date of Peak Production
  - Peak Hour Production, GPM taken from DOH formula
- Metered Consumption Data
  - Annual Residential Consumption, MG
  - Average Day Consumption per Residential Customer (ERU), Gal
  - Annual Commercial Consumption
  - Total Annual metered Consumption, MG
  - Residential ERU Count based on Average Day Consumption
  - Commercial ERU Count based on Average Day Consumption/ERU
  - Total ERU Count based on Average Day Consumption
  - Annual Un-accounted Water DSL (Distribution System Leakage)
  - Un-accounted Water DSL as ERU
  - Percent (%) Un-accounted Water DSL

WATER USAGE REPORT

Information Reference Source / Units--->	Years	TOTAL CONNECTIONS Count	Commercial Connections Count	Single Family Residential Units (RU) Count	Average Household Size Census	Population Served Census	TOTAL ANNUAL* PRODUCTION MG	Line flushing/other AC (Authorized Consumption) MG	Net Annual Production MG	Average day Source Production MG	System ERU Count Average Day ERU	Peak Day Production MG/day	Peak Day Production per ERU Gal/day	Peak Day Production GPM GPM	Date of Peak Production	Peak Hour Demand (PHD) using DOH peaking formula GPM	Annual Residential Consumption MG	Average Day Consumption per Residential Customer (ERU) Gal	Annual Commercial Consumption MG	TOTAL ANNUAL METERED CONSUMPTION MG	Residential ERU count Average Day Consumption ERU	Commercial ERU count based on Average Day consumption ERU	Total ERU Count based on Average Day consumption ERU	Annual Un-accounted Water DSL (Distribution System Leakage) MG	Unaccounted Water /Distribution System Leakage as ERU ERU	% Annual Un-accounted Water DSL (Distribution System Leakage) Percent	Notes
		********DEMOGRAPHIC DATA**********					********METERED SOURCE PRODUCTION DATA**********										********METERED CONSUMPTION DATA**********										
PSRC	**1970**				3.45																						
Comprehensive Water System Plan 1973	**1972**	700	4	696	2.700	1880	109.5	0.487	109.0	0.300		0.850		590													consumption data not available prior to 1995
Comprehensive Water System Plan 1984	**1979**	770	4	766	2.636	2019	114.8	0.487	114.3	0.315		0.908		630	27-Jun-79												consumption data not available prior to 1995
	1980	780	4	776	2.785	2161	118.3	0.487	117.8	0.324		0.978		679	18-Jul-80												consumption data not available prior to 1995
	1981	790	4	786	2.760	2169	109.0	0.487	108.5	0.299		0.713		495	31-Jul-81												consumption data not available prior to 1995
	1982	800	4	796	2.735	2177	114.6	0.487	114.1	0.314		0.924		641	20-Jun-82												consumption data not available prior to 1995
	1983	810	4	806	2.710	2184	108.6	0.487	108.1	0.297		0.882		613	22-Aug-83												consumption data not available prior to 1995
Interpolated Data + PSRC	**1990**	828	4	824	2.535	2088	112.7	0.487	112.3	0.309		0.820		569													consumption data not available prior to 1995
Comprehensive Water System Plan 2006	**1995**	840	4	836	2.489	2081	115.7	0.487	115.2	0.317	982	0.775	789.4	538	30-Jun-95	875	98.5	322.9	15.6	114.1	836	132.3	968.3	1.10	9.3	1.0%	old turbine type master meter under recording
	1996	844	4	840	2.480	2083	100.5	0.487	100.0	0.275	856	0.626	731.0	435	24-Jul-96	814	98.5	321.4	15.6	114.1	840	132.9	972.9	-14.16	-120.7	-14.1%	old turbine type master meter under recording
	1997	845	4	841	2.471	2078	94.9	0.487	94.4	0.260	809	0.573	708.6	398	12-Aug-97	791	98.7	321.6	10.3	109.0	841	87.4	928.4	-14.55	-123.9	-15.3%	old turbine type master meter under recording
	1998	850	4	846	2.461	2082	125.5	0.487	125.0	0.344	1157	0.684	591.4	475	9-Jul-98	666	91.8	297.3	10.0	101.8	846	92.0	938.0	23.23	214.1	18.5%	
	1999	850	5	845	2.452	2072	103.8	0.487	103.3	0.284	1152	0.453	393.1	315	24-Sep-99	449	76.1	246.8	10.7	86.8	845	118.7	963.7	16.51	183.2	15.9%	
	2000	851	5	846	2.443	2067	111.8	0.487	111.3	0.306		0.679		472	4-Aug-00	18							0.0				consumption data not available for 1999
	2001	850	5	845	2.453	2073	93.7	0.487	93.2	0.257	1204	0.424	352.2	294	12-Sep-01	404	65.8	213.2	11.2	77.0	845	144.5	989.5	16.19	208.1	17.3%	leaks on 182nd??
	2002	855	5	850	2.462	2093	90.3	0.487	89.9	0.248	1002	0.626	624.6	435	29-Oct-02	705	76.6	247.0	10.1	86.7	850	111.8	961.8	3.16	35.1	3.5%	
	2003	858	5	853	2.472	2109	102.4	0.487	101.9	0.281	1122	0.563	501.7	391	31-Jul-03	572	77.9	250.1	9.7	87.6	853	106.3	959.3	14.38	157.6	14.0%	
	2004	860	5	855	2.482	2122	97.6	0.487	97.1	0.267	1143	0.561	490.7	390	29-Jul-04	561	73.0	234.0	11.8	84.9	855	138.7	993.7	12.28	143.8	12.6%	
	2005	864	5	859	2.492	2140	93.9	0.487	93.4	0.257	1216	0.445	366.0	309	4-Aug-05	425	66.4	211.7	9.1	75.5	859	117.8	976.8	17.99	232.8	19.1%	brightwater pumping tests?
Recorded Data - Master Meter Flow Record	**2006**	866	5	861	2.501	2154	106.8	0.487	106.3	0.293	1319	0.698	529.1	485	9-Aug-06	607	69.7	221.8	9.9	79.6	861	121.8	982.8	26.75	330.5	25.0%	
	2007	871	5	866	2.511	2174	88.1	0.487	87.6	0.241	1203	0.506	420.6	351	15-May-07	488	63.4	200.5	8.4	71.8	866	115.1	981.1	15.77	215.4	17.9%	leaks on Ballinger??
	2008	871	5	866	2.521	2183	115.6	0.400	115.2	0.317	1640	0.575	350.6	399	15-Aug-08	410	61.1	193.2	8.1	69.1	866	114.4	980.4	46.10	653.8	39.9%	leaks on Ballinger??
	2009	873	5	868	2.530	2196	106.8	0.635	106.2	0.293	1311	0.730	556.6	507	30-Jul-09	642	70.7	223.2	9.1	79.8	868	111.9	979.9	26.38	323.8	24.7%	
	2010	874	5	869	2.540	2207	84.0	0.465	83.5	0.230	1218	0.460	377.7	319	9-Jul-10	442	59.9	188.9	10.4	70.4	869	151.5	1020.5	13.14	190.6	15.7%	
	2011	876	5	871	2.545	2216	79.0	0.182	78.9	0.217	1209	0.554	458.2	385	22-Jun-11	533	56.9	179.1	9.7	66.7	871	148.7	1019.7	12.20	186.6	15.4%	
	2012	878	5	873	2.549	2225	83.5	1.679	81.9	0.229	1254	0.491	391.5	341	17-Aug-12	459	58.2	182.5	9.3	67.5	873	139.5	1012.5	14.41	216.3	17.2%	
	2013	889	16	873	2.554	2229	93.0	1.462	91.5	0.255	1406	0.440	313.0	306	15-Jul-14	370	57.8	181.2	9.5	67.2	873	143.2	1016.2	24.32	367.6	26.1%	6 res. accts. Changed to Comm. class
	2014	889	16	873	2.558	2233	91.8	1.132	90.7	0.252	1355	0.630	464.9	438	13-Jul-14	542	59.2	185.7	9.3	68.5	873	137.7	1010.7	22.21	327.8	24.2%	re-numbering accounts
Projected Values	**2015**	891	17	874	2.563	2240	94.3	0.742	93.5	0.258	1312	0.775	590.5	538		765	62.3	196.8	9.3	71.6	868	130.2	998.1	21.93	304.5	22.5%	********projected data**********
	2016	894	17	877	2.567	2251	94.5	0.744	93.8	0.259	1295	0.779	601.6	541		784	64.0	199.9	9.3	73.3	877	127.9	1004.9	20.42	279.9	21.6%	********projected data**********
	2017	896	18	878	2.572	2258	94.0	0.748	93.3	0.258	1300	0.781	601.1	543		785	63.5	198.1	9.4	72.9	878	130.1	1008.1	20.35	281.3	21.6%	********projected data**********
	2018	898	19	879	2.576	2264	92.8	0.754	92.0	0.254	1295	0.784	605.2	544		793	63.0	196.4	9.5	72.5	879	132.7	1011.7	19.53	272.5	21.0%	********projected data**********
	2019	900	19	881	2.581	2273	92.6	0.762	91.8	0.254	1290	0.787	610.0	546		802	63.3	196.7	9.7	72.9	881	134.5	1015.5	18.93	263.6	20.4%	********projected data**********
COMPREHENSIVE SYSTEM PLAN 6 YEAR SCENARIO	**2020**	**903**	**19**	**884**	2.585	**2285**	**92.0**	**0.772**	**91.2**	**0.252**	**1279**	**0.791**	**618.2**	**549**		**816**	**63.6**	**197.1**	**9.8**	**73.4**	**884**	**136.9**	**1020.9**	**17.79**	**247.4**	**19.3%**	**********projected data**********
Projected Values	**2023**	906	20	886	2.589	2294	90.2	0.785	89.4	0.247	1252	0.794	634.0	551		840	63.8	197.4	10.1	73.9	886	140.0	1026.0	15.49	215.1	17.2%	********projected data**********
COMPREHENSIVE SYSTEM PLAN 10 YEAR SCENARIO	**2025**	908	21	887	2.592	2299	89.2	0.800	88.4	0.244	1237	0.796	643.3	552		855	64.0	197.6	10.4	74.3	887	143.6	1030.6	14.07	195.1	15.8%	********projected data**********
Projected Values	**2030**	919	23	896	2.599	2329	88.2	0.825	87.4	0.242	1220	0.806	660.7	560		888	64.8	198.1	10.8	75.6	896	148.9	1044.9	11.81	163.3	13.4%	********projected data**********
COMPREHENSIVE SYSTEM PLAN 20 YEAR SCENARIO	**2033**	**926**	**24**	**902**	**2.608**	**2352**	**87.0**	**0.858**	**86.1**	**0.238**	**1199**	**0.814**	**678.9**	**565**		**922**	**65.5**	**198.8**	**11.3**	**76.8**	**902**	**155.9**	**1057.9**	**9.38**	**129.3**	**10.8%**	**********projected data**********

Annual production based on master meter totalizer values at beginning and end of year (blue), and average of recorded days (red) data as available

Line flushing/other uses based on Manager records; pre 2008 estimated based on average 2008-2012

Double border signifies 10 year average

UNCERTAIN DATA IS RED

PSRC / US CENSUS DATA IS GREEN

INTERPOLATED DATA IS BLUE

PROJECTED DATA IS SHADED YELLOW

NORMAL RECORDED DATA IS BLACK NO SHADE

Edit: February 26, 2015

file: Raid-2\Water Usage|Water Usage Report.xls

Table 2-1 Water Usage Report

Some observations are helpful in understanding the data in Table 2-2:

- Current Peak (Max) Day Production is projected at 0.775 MG/day. This is based on historical record on June 30, 1995 and reflects current usage patterns. Water production records for 1995 appear in Appendix 2-A. In the decades previous to 1995 the Peak Day Production was known to be much higher. Alternate methods of determining Peak Day Production were compared with the following results:

METHODS OF ESTIMATING MAX (PEAK) DAY PRODUCTION COMPARED	Kgal/day	System GPM	Gal/ Day/ ERU
MMAD (Max Month Average Day - July)	410	285	472
WSDOH Water Des. Man. recommended MDD=MMADx1.7	697	484	802
Maximum Day Summer Months: Average June-August	728	506	839
WSDOH Water Des. Manual 2009 Appendix "D" Average Day x 2	524	364	604
WSDOH (pre-1986) --> 800 gallons per ERU /day (Western WA)	994	690	1145
Historical Record 6/30/1995 --> 775 Kgal	**775**	**538**	**893**
Edit: January 15, 2015			
file: Raid-2\Water Usage\Water Usage Report.xls			

- Annual Production (MG) is projected based on historical 10-year average and projected values are incremented by anticipated growth in the service population.
- ERU Count based on production data are projected to decline as un-accounted water losses (presently near 20%) are reduced through system pipe replacements and meter replacements.
- Total annual production of water is expected to decline marginally through the plan period as the effect of increased service population is offset by reduction in un-accounted water that will be realized through pipe replacements and customer meter replacements.
- Peak Hour demand (gal/min) is estimated using a formula provided by Washington DOH as it appears in the Water System Design Manual – current edition.
- Data are color coded to represent source and level of certainty.

Figure 2-5 graphically illustrates some of the data shown in **Table 2-1** along with historical ADD from 1972 through 2012.

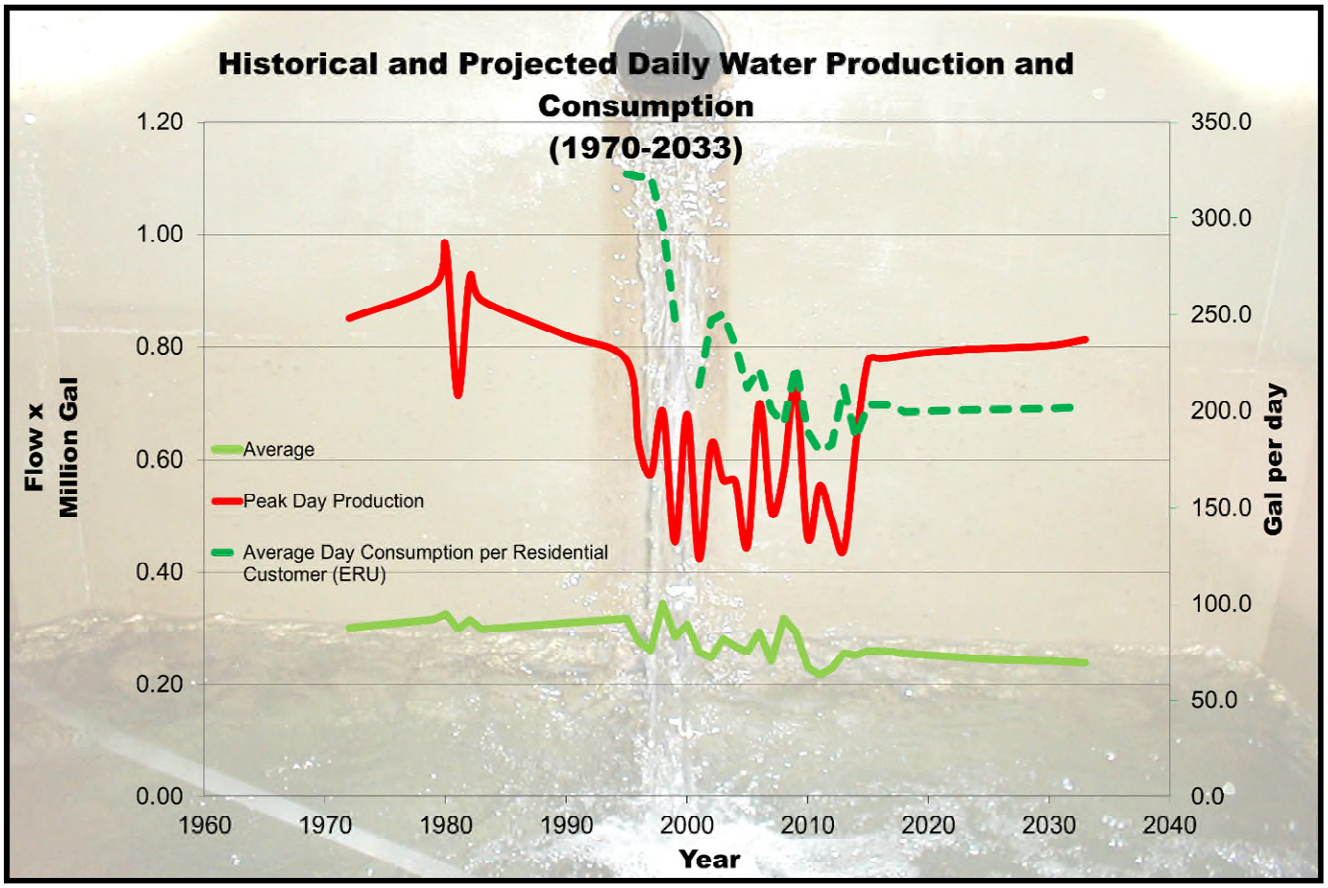


Figure 2-5 Historical and Projected Water Production and Consumption
\\Raid\raid-2\Water Usage\Water Usage Report.xls

PART THREE - FACILITY CONDITION AND PERFORMANCE ANALYSIS

A thorough review of the condition and performance of District facilities sets a foundation for the comprehensive Capital Improvement Plan outlined in Part VIII. Part Three contains two sections:

I "Descriptive Evaluation"
II "Hydraulic Model & Report"

The findings in both sections are needed to identify needs and prescribe appropriate improvements to the system.

I. DESCRIPTIVE EVALUATION OF DISTRICT FACILITIES

This section outlines design and performance standards for each class of District infrastructure along with a description of current condition. Detailed hydraulic analysis of the system is covered in the next section. For a generalized evaluation of District facilities the reader may also consult the most recent Department of Health "Sanitary Survey" report. A copy of the current Sanitary Survey report can be found in **Appendix 3-A**

1. OVERVIEW AND OBJECTIVES

Two principal objectives of this section are:

1. Outline the District's design and performance standards
2. Describe the condition of major components of the District's facilities and their ability to meet performance standards, based on operational history, inspection, and modeled performance.

The District's physical facilities fall into five general categories. These include:

- Source and supply infrastructure, wells, and pumps.
- Water quality and treatment.
- Storage distribution reservoirs.
- Distribution pipes, pressure control, isolation valves and fire hydrants.
- Service lines and meters.

The following sections briefly outline performance standards and the current condition of each of these categories of infrastructure. Where deficiencies exist, improvement alternatives are identified and assessed for feasibility. An itemized summary of system improvements and priorities follows in Part Eight of this document, along with a proposed implementation schedule.

SOURCE AND SUPPLY INFRASTRUCTURE

(a) Design and Performance Standards

- Sources shall be capable of replacing required fire storage within 24 hours, at maximum day flow conditions.
- All system design to meet Good Engineering Practice and DOH guidelines as outlined in DOH "Water System Design Manual", dated December, 2009, DOH 331-123 (REV. 12/09).
- Minimum source capability shall be 1,000 gallons per connection per day.
- Well development shall conform to Minimum Standards for Construction and Maintenance of Wells Chapter 173-160 WAC, March 13, 1990. District will promote interties with adjacent water utilities as backup sources to improve emergency supply. Pump stations to be provided with auxiliary power connections for independent operation.
- Pump redundancy shall provide for a minimum the MDD when the largest pump is out of service.
- Source structures shall be constructed and sited for maximum resistance to damage from vandalism, fire, wind, falling trees and flooding.
- District will endeavor to protect the sources through implementation of a Source Protection Plan, as outlined in Part Five of this document.
- Supply works shall be protected from damage by incorporating drainage, ventilation, prefabrication, PRV, and by necessary protective measures such as site drainage, tree clearing and grading as needed to insure reliability of service.
- District will place maximum priority on constructing mutually beneficial emergency interties with neighboring systems.
- District will develop and adhere to standard designs for pressure reducing and valve chambers where possible.

(b) General Overview

LFWD is one of only a few Class A water purveyors in King County that produce from their own wells instead of purchasing from a regional wholesale supplier. The District discussed the option of bulk purchasing from Seattle in the 1950's during a period of system growth and water shortages. This option has not been considered further as the District was successful in developing its deep well sources a few years later. Presently LFPWD is committed to utilizing its own wells as a primary source while also maximizing the benefit of emergency interties.

There are many recognized benefits of "in-house" water production for LFPWD including:

- Low cost of production compared to purchased water – has been estimated at under $200/MG (SPU wholesale cost 2014 is approx. $2,000/MG off-peak to $3,000/MG peak)
- No block purchase requirements, peak use quota limits or usage restrictions
- Aesthetic value of "natural" deep and artesian well water which is appreciated by customer base
- Relative control against long term increases in cost. No concerns with Disinfection By Products (DBP's) or other issues related to surface water

Table 3-1 summarizes capacity of the District's current water supply and sources, both normal and emergency.

Source Capacity and Demand Information									
	INSTANTANEOUS QUANTITIY WATER					ANNUAL QUANTITY WATER			
	2014	2020	2025	2033	Water Right/Intertie Allowance**	2014	2020	2025	2033
Well Sources (Available Water)	gpm		gpm	gpm	gpm	ac-ft	ac-ft	ac-ft	ac-ft
Deep Well #1	300	300	300	300	100	162	162	162	162
Deep Well #2	300	300	300	300	440	704	704	704	704
Deep Well #3	350	350	350	350	225	pooled	pooled	pooled	pooled
Deep Well #4 (not DOH approved yet)	0	340	340	340	pooled	pooled	pooled	pooled	pooled
Deep Well #5 (Horizon View #1)	250	250	250	250	pooled	pooled	pooled	pooled	pooled
Deep Well #6 (Horizon View #2)	150	150	150	150	pooled	pooled	pooled	pooled	pooled
Artesian	100	100	100	100	208	336	336	336	336
Total from District sources*	**1450**	**1790**	**1790**	**1790**	**973**	**1202**	**1202**	**1202**	**1202**
Intertie Sources (Available Water)									
Existing NUD Intertie at District WHPA (Emergency - no comitted storage, limited only by physical capacity of intertie valves)	500	500	500	500	*N/A****	Undetermined			
Existing City of Seattle - Tolt System redundant supply Horizon zone Intertie/Meter/PRV at 195th Street (source limited by agreement to 3,500 gpm and by physical capacity of intertie piping to 2,150 gpm)	1200	2150	2150	2150	*3500.00*	Maximum 1 week at 3,500 gpm - Longer duration upon approval			
Future City of Seattle - Tolt System redundant supply Horizon Zone Intertie/Meter/PRV at 193rd Street (existing agreement) 10" DI				2500					
Total Intertie Capacity	**1700**	**2500**	**2650**	**3500**	***3500.00***				
Total System Emergency Capacity	**3150**	**4290**	**4440**	**5290**	***4473.00***	**Not Computed for Sustained Use**			
Demand (Required Water)									
Peak Hour Demand, gal/min	717	784	813	816	*Annual ac-ft/yr*	**233.2**	**242.7**	**245.8**	**252.2**
Peak Day Demand (aka "Max Day Demand), gal/min	538	550	555	564					
Residential Fire Demand, gal/min	1000	1000	1000	1000					
Commercial/Institutional Fire Demand (maximum), gal/min	3500	3500	3500	3500					
Residential Fire System Peak Demand	**1538**	**1550**	**1555**	**1564**					
Commercial Fire System Peak Demand	**4038**	**4050**	**4055**	**4064**					
Edit: 1/22/2015									
Raid2\System Plan\NetworkHydraulics.xls									
*water rights are aggregated as a single wellfield									
** figures shown in italic are based on intertie									

Table 3-1 Source Capacity Information
\\Raid\raid-2\Water Well Info\Network Hydraulics.xls – Excel

The District has a total of 6 deep wells in 2 wellfields which both draw from the same aquifer. A description of each wellfield follows.

All the deep wells are in operable condition with no serious production limitations other than McKinnon Creek DW #4 which is presently not connected and is available as standby only. DW #3 has demonstrated artesian properties on occasion, with a static level up to 3 ft above the surface. **Table 3-2** summarizes important operational and design information for each deep well.

Physical Information - Deep Wells

Parameter	DW#1	DW#2*	DW#3	DW#4 (backup)	HV DW#1	HV DW#2
Latitude	47 deg. 45' 51.49280" N	47 deg. 45'51.40966" N	47 deg. 45' 47.85774" N	47 deg. 45' 47.10645" N	47°46'21.6"N	47°46'21.63"N
Longitude	122 deg. 16' 44.01628" W	122 deg. 16' 44.98029" W	122 deg. 16' 46.24330" W	122 deg. 16' 43.69710" W	122°16'46.3"W	122°16'47.75"W
DOE ID #	AFJ001	AFJ 002	AFJ 003	AFJ 004	BAM-416	BAM-417
DOH Source #	S05	S05	S05	S05	S10	S11
Elevation of well cap (NAVD 88)	approx 294	approx 287	approx 262		552	557
Sensor Depth (from well cap)	150	165			369.4	364.75
Depth (from well cap)						
- Wellhead	0	0	0	0	0	0
- Static W.S.		55	3ft Above ground		286.7	293.6
- Drawdown (at cap)						
- Pump Inlet	172	172	158	178	377	371
- Packing		177	140	188	337.5	328.5
- Screen (top)		178	143	188	377.5	379
- Screen (Joint1)			149	193	398.5	404.5
- Screen (Joint2)				199	442	442
- Screen (bottom)				204	457.5	452.5
- Sediment	216	187	156	208		
- Bottom	216	190	161	208	467	467.5
- Diameter (inches)	8	8	12	8	16/12	16/12
Initial Development	1958	1961	1967	1989	2009	2009
Last inspection/cleaning of casing		1994	1994			
Continuous pumping capacity (single pump)	300	300	350	340	300	250

raid 2:\Water Well Info\Summary Well Information.xls

updated 12/09/14

***Important note: the nomenclature of wells #1, 2 was reversed on May 2, 1994** by the District Manager.*

Table 3-2 Deep Well Information

\\Raid\raid-2\Water Well Info\Summary Well Information.xls – Excel

(c) McKinnon Creek Wellfield Protection Area (near 187th Street)

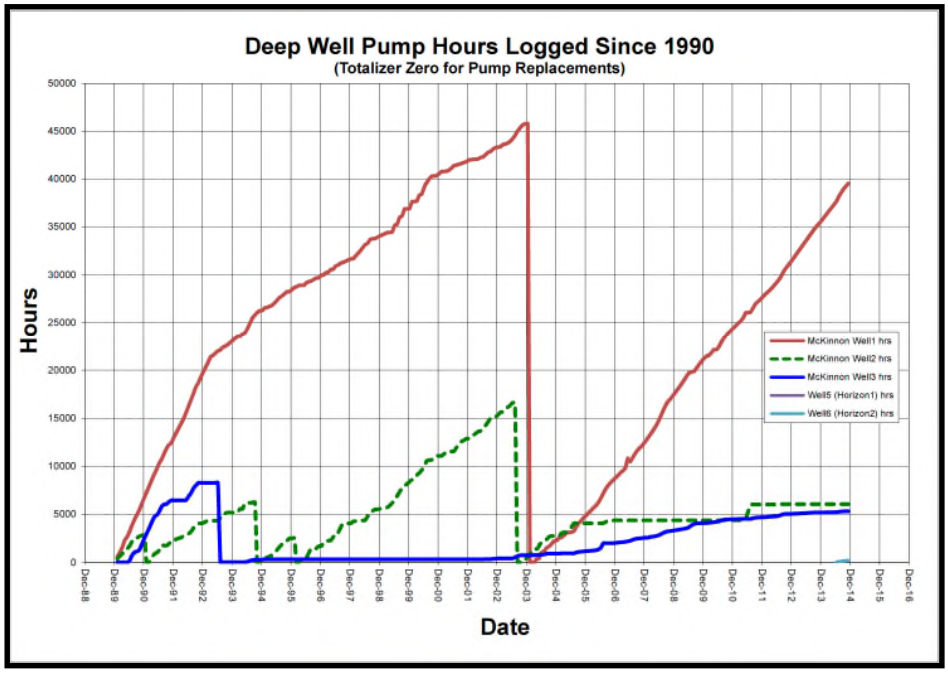
McKinnon Cr. wellfield (formerly known as "East Watershed") is located on a 12 acre forested property which the District owns in the vicinity of 49th Place and 187th Street. See **Figure 3-1** for a map of the McKinnon Creek wellfield. Surrounding the McKinnon Cr. wellfield is a forested valley with steep sides, bisected by a drainage course and a utility access road. Access from the north is off NE 187th Street and access from the south from #18460 47th Place. The District has fenced portions of the WHPA boundary, and access is restricted by locked gates.

The District or its predecessor has utilized McKinnon Cr. Wellfield since the earliest development of the community of Lake Forest Park around 1909-1910. There is an undeveloped and previously abandoned right-of-way through the property and there has been discussion by the LFP City about the creation of a walking trail along McKinnon Creek through the WHPA. If trails are ever constructed through the WHPA, critical District facilities would need to be sufficiently protected against vandalism, traffic and potential water quality impacts and the District would need to have adequate jurisdiction over the area to comply with Washington State law (WAC 246-290-135) and meet the satisfaction of WSDOH so as to ensure continued use of the wells. Additionally, public access would need to comply with existing and future federal standards.

In 2014 the District initiated Quiet Title action with the City of LFP under RCW 7.28.010 in hope of clearing the ambiguity of ownership and control over this area. Further discussion of the watershed follows in Part Five of this plan.

Several improvements are identified for the McKinnon Creek deep wells over the next six years including:

1. Retrofits to DW#3 well casing, well seal and wellhead to safeguard against surface water intrusion.
2. Automated low level shut-down of deep well pumps for protection
3. Inspect and refurbish screen/packing on DW#2 to reduce drawdown.
4. Repair/Replace submersible well pump on DW#1 – service records show that this pump has over 40,000 operating hours and may be nearing end of life (see chart inset).
5. Fencing improvements to repair/replace older fencing and to install new fencing.



In addition to deep wells the District has eight, formerly nine, artesian wells that are located near the deep wells in the heart of the District's McKinnon Creek wellfield. These eight artesian wells are cased with six inch PVC that is slotted on the lower end. Up until 1958 the artesian wells of the McKinnon Creek wellfield, and the now sold and developed "west watershed", were the only sources for the District. Due to increasing demand these sources became inadequate, and the District examined various options including purchase of Seattle water. In the late 1950's the District opted to drill deep wells in the McKinnon Creek WHPA.

Summary Information - Artesian Wells at McKinnon Creek

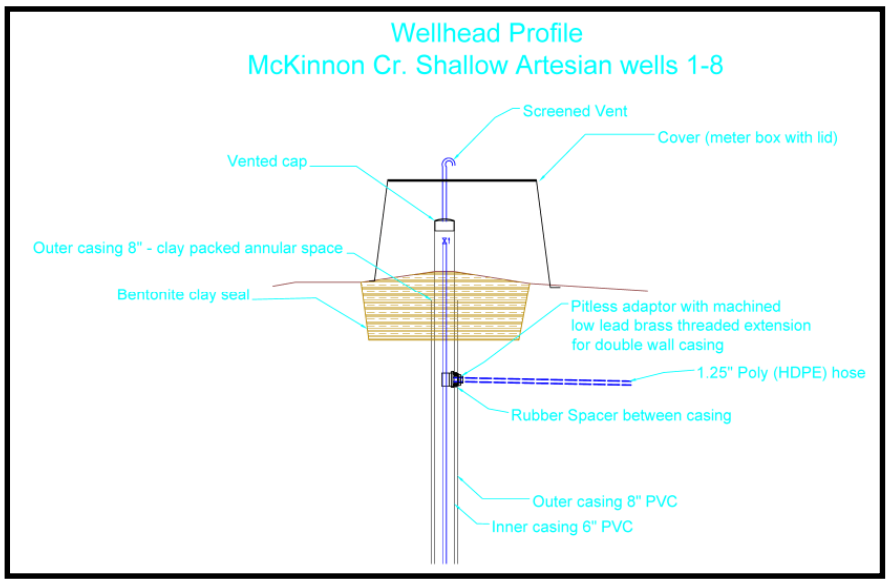
Well#	Latitude	Longitude	DOE ID #	DOH Source #	Approx. Flow, gpm	Casing Size, inches	Depth, ft (approx.)	Drawdown (165gpm combined) demand test Jan 11/89	Static Level	Condition
#1	47 deg. 45' 51.40686" N	122 deg. 16' 45.54195" W	AFJ 005	S06	10	6	18.5	6	surface	operating
#2	47 deg. 45' 51.56784" N	122 deg. 16' 44.70763" W	AFJ 006	S06	10	6	18	15	surface	operating
#3	47 deg. 45' 51.06263" N	122 deg. 16' 44.85502" W	AFJ 007	S06	10	6	25	17	surface	operating
#4	47 deg. 45' 50.94975" N	122 deg. 16' 44.85502" W	AFJ 008	S06	10	6	23	9	surface	operating
#5	47 deg. 45' 50.17831" N	122 deg. 16' 45.07703" W	AFJ 009	S06	10	8	23	16	surface	operating
#6	47 deg. 45' 49.91400" N	122 deg. 16' 44.99205" W	AFJ 010	S06	10	8	19	14	surface	operating
#7	47 deg. 45' 48.77817" N	122 deg. 16' 45.03226" W	AFJ 011	S06	10	6	17	5	surface	operating
#8	47 deg. 45' 48.61775" N	122 deg. 16' 45.09303" W	AFJ 012	S06	10	6	21.5	10	surface	operating

file: raid2:\Water Well Info\Summary Well Information.xls

Table 3-3ARTESIAN Well Information

The wells are truly artesian springs and will discharge to the ground surface. However they are fitted with pitless adapters about 3ft below grade which convey water to a collection cistern, where it is pumped into the McKinnon Creek Low zone reservoir. This has a draw down effect, so the water levels in the wells while producing are normally several feet below ground surface. All of the artesian wells are in satisfactory condition following the District's replacement of supply piping from the well heads to the manifold and collection cistern in the 1990's and construction of wellhead pitless adapters in 2005 (see wellhead detail below). The combined wells have in recent years produced about 80-100 gpm on average. Observation and monitoring by the District over several decades indicates that the production and quality of these wells is seasonally constant, indicating little or no influence of surface water. This is surprising considering the depth of the wells. A recent Record of Examination of Water Rights by Washington Department of Ecology suggests that these wells may in fact be springs draining from the Vashon Advance outwash (Qva) aquifer.

The McKinnon Creek artesian wells are presently a small portion of overall production. However the District values the wells for other reasons including water rights, public appreciation for artesian sources, and for the inherent reliability of a gravity source in the event of an emergency.



In recent years, the District has had discussions with King County emergency services regarding possible use of the wells as a regional emergency water supply. In addition the District has dialogued with local area bottled water companies who may be interested in purchasing artesian water. At the present time there are no definite plans but this is seen as a possibility for profitable use of this source. Several issues would need to be examined in the event this course is pursued further, including water rights, delivery, long-term water quality, liability and profitability.

(d) Horizon View Wellfield

Horizon View Wellfield lies on a 1.8 acre parcel immediately north of the SPU reservoir at 195th Street & 45th Ave. (Address: 19568 45th Ave. Parcel #4027700071). The site is bounded to the north by the LFP City owned Horizon View Park and on the west there is a steep embankment sloping to 197th Street. Vehicular access to the Horizon View wellfield from 45th Ave. is restricted by locked bollards. Pedestrian access is permitted along the utility access road which connects with the park.

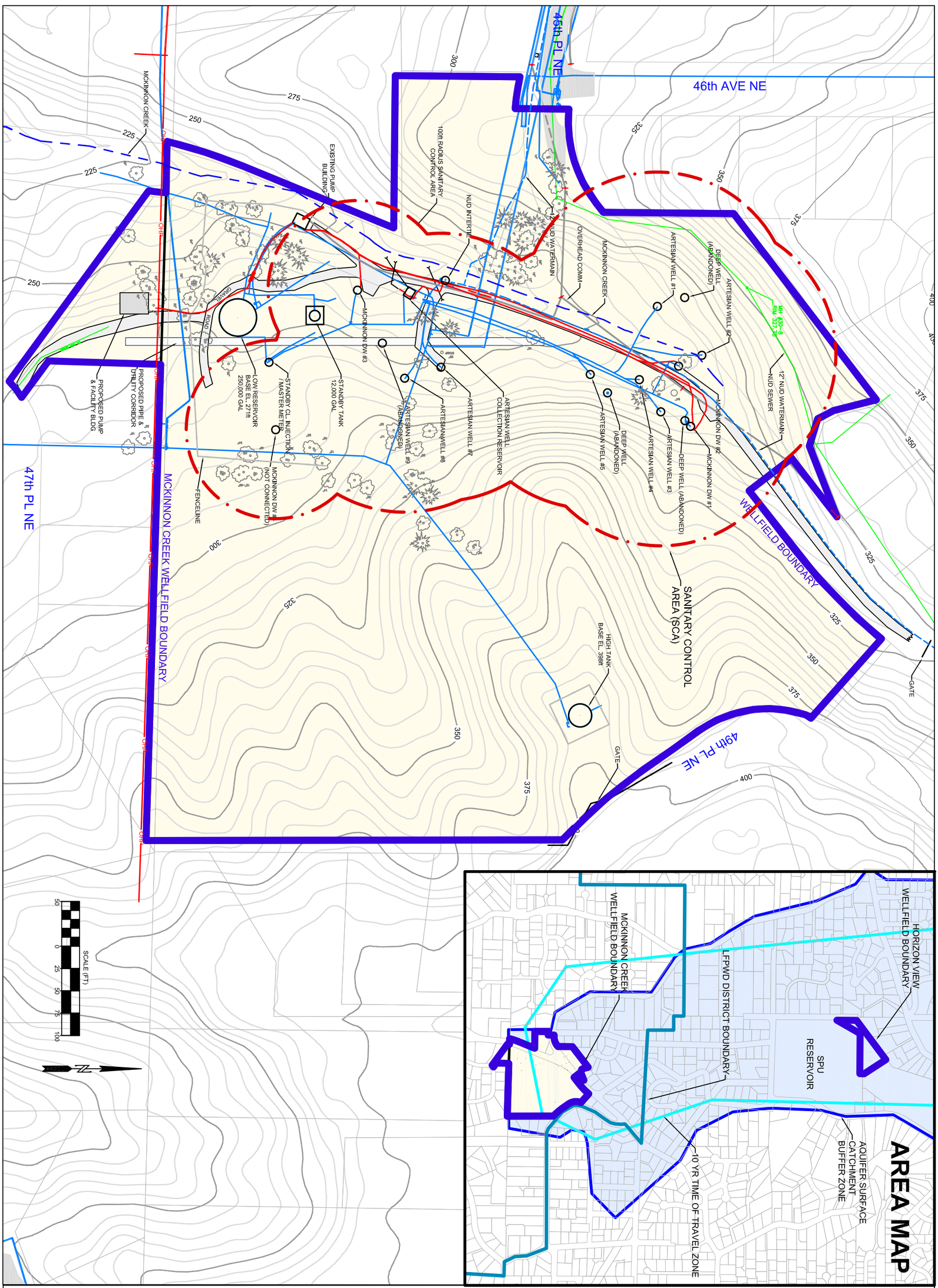
The Horizon View wellfield site was purchased in 2011 from the City of Seattle who regarded the property as surplus. There are easements, covenants and other particular encumbrances that were conveyed with the title which impact use of the property. A complete description appears in the title document found in **Appendix 3-B** but are briefly and incompletely summarized here:

- Non-exclusive 10ft access easement around Seattle reservoir property
- Utility easement along access road (west reservoir boundary)
- No aboveground structures or trees within 10ft of reservoir boundary
- Written approval before construction or alteration along west boundary above steep slope

Development of the Horizon View wellfield was completed with a majority of construction funds ($2 Million) coming from a 2003 mitigation agreement between LFPWD and King County. Part of this agreement included construction of backup wells and infrastructure in case the Brightwater tunnel under 195th St. ever damaged the LFP aquifer. Originally the wells were to be developed by King County but the District assumed responsibility for construction as part of a mediated agreement in 2008.

Some of the infrastructure constructed with this project includes:

- 2 – deep wells, 465 ft deep, 16”/12” casing. Wells are covered with faux boulders
- Pump control facility. Includes pipe gallery and metering.
- 50,000 gallon welded steel reservoir
- Gravel access road and about 100 ft embankment retaining wall
- Drainage, electrical, and communications utilities all underground
- On-site and off-site transmission main (mostly 8” DI off-site and HDPE on-site)
- 10”x4” PRV chamber to prioritize water from Horizon View wellfield but admit water from Seattle on pressure drop.

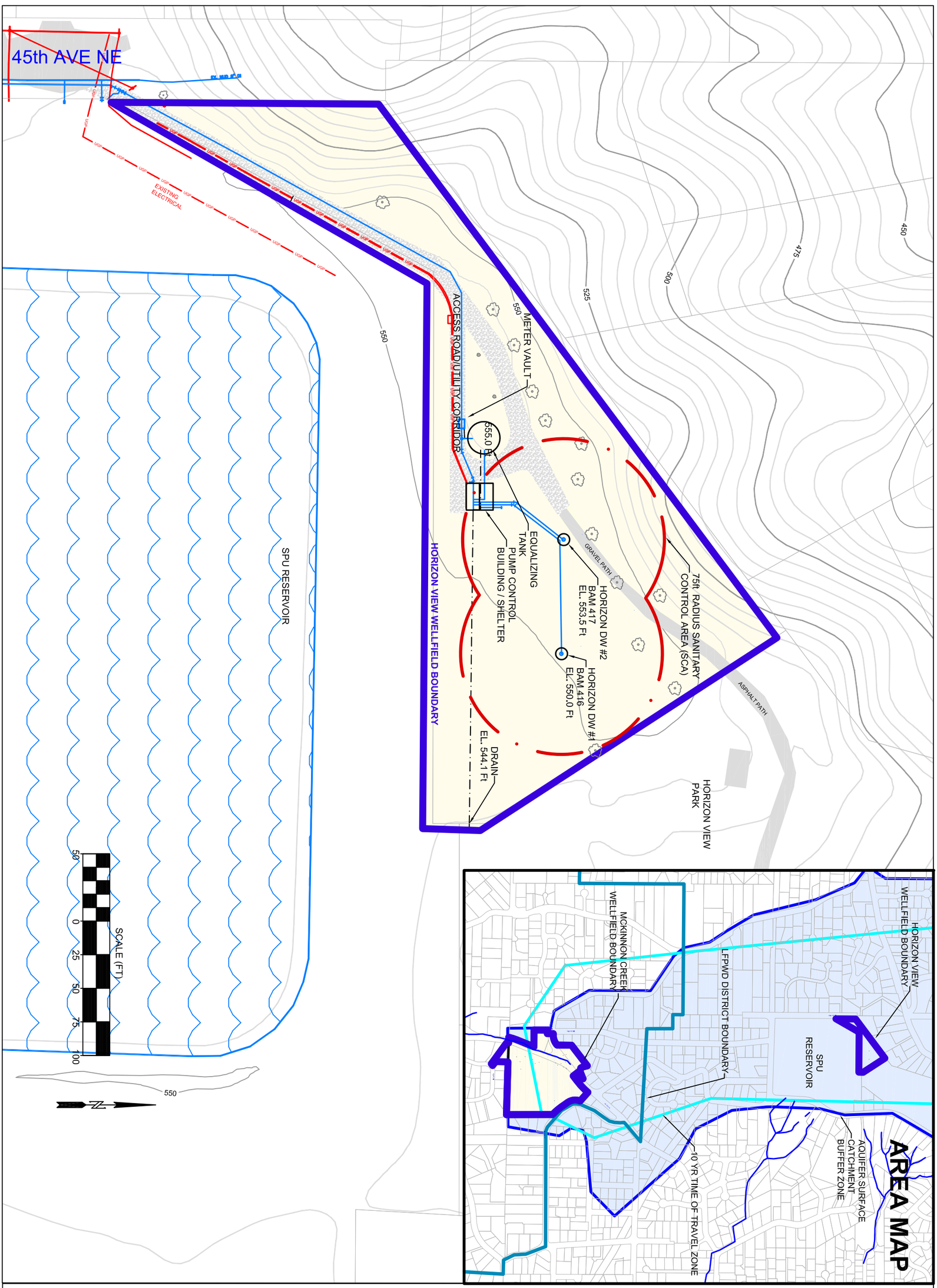


LAKE FOREST PARK WATER DISTRICT
MCKINNON CREEK WELLFIELD MAP
Showing Current and Proposed Infrastructure, Various Boundaries, and Topography

FIGURE 3-1

MUNDALL ENGINEERING &
CONSULTING
P.O. Box 700
Sumas, Washington 98295
Bus. (360)-855-0285
FAX (360)-855-2276
P.O. Box 50
Lytton, B.C. V0K 1Z0
Cellular (360)-319-1283
E-MAIL DonMundall@...com

LAKE FOREST PARK WATER DISTRICT
GOOD WATER NATURALLY



LAKE FOREST PARK WATER DISTRICT
HORIZON VIEW WELLFIELD MAP
Showing Current Utilities and Infrastructure, Various Boundaries, and Topography

FIGURE 3-2

LAKE FOREST PARK WATER DISTRICT
GOOD WATER NATURALLY

MUNDALL ENGINEERING &
CONSULTING
P.O. Box 799
Sumas Washington 98295
Ph: (250) 450-0385
Fax: (250) 450-2276
P.O. Box 50
Lytton, B.C. V0K 1Z0
Cellular: (250) 319-1285
Email: jon@mundall.com
(800) 313-9705

(e) Supply Infrastructure - Condition, Deficiencies and Improvements

Supply infrastructure conveys water from source to distribution. The District's supply infrastructure principally consists of:

District's own groundwater Sources:

- four deep well pumps in McKinnon Creek wellfield
- two deep well pumps in Horizon View wellfield
- shallow well manifold, cistern and transfer pump station at McKinnon Creek wellfield
- High zone transfer pumps and control building at McKinnon Creek wellfield

Emergency Interties:

- NUD intertie piping and valves vault in McKinnon Creek wellfield
- SPU Intertie piping and valves near Tolt pipeline on 195th Street

Water is normally pumped directly from wells at McKinnon Creek wellfield to the District's Low Zone HGL 292 reservoir where it supplies about half of the total customers in District by gravity. Water is also lifted from the low zone reservoir to HGL 452 by the McKinnon Creek high zone transfer pumps.

Since 2014 the District has also supplied water from the Horizon View wellfield where it is conveyed by gravity from the 50,000 gal equalizing tank through transmission mains along 45th Ave., 195th St., 46th Ave. to the McKinnon Creek wellfield and admitted to the High zone through timer valve and pressure reducing valves. Approximately 1000 gpm is available to the high and intermediate zones from this connection at present.

Table 3-4 (on the following page) summarizes relevant physical information for all pumps used in the District.

All deep well pumps and both transfer pump stations are operational. However several improvements have been identified for the deep well and transfer pumping system to improve reliability and capacity. These include:

1. The District is in the process of replacing the high zone transfer pump station with a new integrated pumping and treatment building. This change will also upgrade site piping to allow redirection of flow and inter connection flexibility for each source and reservoir. It would also consolidate several operations in the McKinnon Creek WHPA that are now in separate small wooden buildings or kiosks. These structures and the pump control equipment have suffered from the damp, shaded environment and are at end of service life. Design and permitting are underway for the new facility which will be located on a well-drained development site at #18460 47th Pl.

Summary Pump Information

Item	Units	DW#1 (McKinnon Cr.)	DW#2 (McKinnon Cr.)	DW#3 (McKinnon Cr.)	DW#4 (McKinnon Cr. backup)	DW#5 (Horizon View #1)	DW#6 (Horizon View #2)	Shallow Artesian Transfer Pump 1 (McKinnon Cr.)	Shallow Artesian Transfer Pump 2 (McKinnon Cr.)	High Zone Transfer Pump 1 (McKinnon Cr.)	High Head Transfer Pump 2 (McKinnon Cr.)
Pump Mfg/HP/RPM/Serial #		Berkley 6120-275	Berkley/7S3L	Berkley/6520-275	Goulds/6DHLC	Berkley 7T40-350	Berkley 7T40-350	U.S./5HP/3600 RPM C536/403T353R185F	Same	ODP/25HP/3500 RPM	ODP/25HP/3500 RPM
Volt/phase/cy/RPM/HP		460/3/60/3600/20	460/3/60/3600/20	480/3/60/3600/25	460/3/60/3600/25	460/3/60/3450	460/3/60/3450	460v/3ph/60cy/4A	Same	460v/3ph/60cy	460v/3ph/60cy
Motor Mfg/Serial #		Franklin/G311-090	Franklin/G311-090	2366156020		12 F19-27-06036A	11 F19-27-06031A				
Pump Type/size/Serial #		6T20-275	6T20-275	B 64136	FP 358659	7T40-350	7T40-350	Berkeley Mdl 2.5 TPMS SN Q170591, 4" Impleller Trim	Same	Aurora Pump 2 1/2 x2x3x7B 341A	Aurora Pump 2 1/2 x2x3x7B 341A
No. Stages		5	4	5	3	6	6				
Pump Curve #		2500 Page 5.01	2500 Page 5.01	ST 2375A	E6206DEPCO	M21898	M21897				
Last Major Insp Or repair of pump	Month-Yr	2/18/2004	11/4/2003	1993	34516	9/20/2012	9/19/2012	33482	Same	1990	Sep-05
Initial Install date of pump	Month-Yr	33270	Nov-03	1991		9/20/2012	9/19/2012	33482	Same	1990	Sep-05
Average hours/day (last 5 years) each pump	hours	10.4	0.9	0.7	0	new	new			0.02	5.3
Total hours on pump (est from records)	hours	39534.6	6055.8	5304.8	20	225	217	not known	not known	50764.8	17634.4
Condition notes:		Replaced 2004 by Aquaflow	Replaced 2003 by Aquaflow	Motor replaced '94	New, flush only	New install by Pumptech Inc.	New install by Pumptech Inc.	air bleed issues	air bleed issues	no observed problems	no observed problems
Next Scheduled Service								Replaced 2005	Replaced 2005	2016 pumps will be relocated to new bldg.	2016 pumps will be relocated to new bldg.
Rated Efficiency at design capacity	%	69%	69%	69%	72%	74.7% (pump)	Same	60	Same	77%	77%
Rated Head	ft elevation	185	185	180	130	350.9	Same	30	Same	175	175
Rated Capacity	gal/min	275	275	300	340	343.5	Same	230	Same	400	400
Inlet HGL (static), lower level	ft elevation	150	130	175		192	Same	255	Same	268.2	268.2
Inlet HGL (static) at upper level	ft elevation	260	260	260		273	Same	257	Same	292	292
Discharge HGL (static)	ft elevation	294	294	294		568	Same	291	Same	452	452
Discharge HGL (dynamic, typical)	ft elevation						Same	317	Same	450.18	450.18
Static Head	ft H2O	144	164	119		295	Same	35	Same	171.9	171.9
Dynamic Head (typical, Simplex mode)	ft H2O	180	180	180		350.9	Same	61	Same	170.08	170.08
Capacity (field measured, Simplex mode)	gal/min	325	325	325		340	Same	133	Same	387	387
Dynamic Head (typical, Duplex mode)	ft H2O					295	Same	N/R	Same	N/R	N/R
Capacity (field measured, Duplex mode)	gal/min	300	300	300			Same	N/R	Same	350	350

Raid2:\System Plan\Summary Pump Information.xls
Edit date: Dec. 10, 2014

Table 3-4 Pump Information
\\Raid\raid-2\System Plan Work\Summary Pump Information.xls – Excel

2. Low level cutoff sensors and controls for all deep wells to prevent pump burnout with loss of supply that happened with Well #3 in 1994. SCADA level sensors & alarm were installed in 2005.
3. Transmission main metering of output from high zone transfer pump pumping.
4. Output piping replacement and valve interconnections for wells #1 and 2 to replace several hundred feet of aging and leaking existing pipe.*
5. Piping connection for well #4, new installation. (HDPE piping in place) *
6. Outlet pipe Low Zone Reservoir – replace about 80 lin-ft of 12" asbestos pipe

*part of integrated pumping facility replacement project discussed in other sections of this plan.

(ii) Interties

In 2011 the District signed a 50 year emergency intertie agreement with SPU which provides for fire protection or other emergencies. Some relevant information regarding the SPU intertie is summarized here:

- SPU agreement allows up to 3,500 gpm for one week duration, and longer on approval
- SPU agreement replaced a 1982 purveyor agreement used to augment fire protection at the Lake Forest Park Towne Center and which expired the end of 2011
- Same agreement can support additional connection points
- agreement was reviewed by WSDOH and is recognized as an emergency intertie for fire protection or other emergency
- 1 MG per year allowed as allowance for maintenance use in the agreement without additional charge
- through a mitigation agreement with King County – Brightwater tunnel project an intertie with SPU was constructed in 2011 to convey water from the SPU Tolt pipeline on 195th Street near 47th Ave. to the McKinnon Creek WHPA for supply to the system
- SPU Tolt intertie is triggered by the 195th St. PRV when the HGL (Hydraulic Grade Line) at 195th St. PRV is <u>less</u> than 548 feet so that priority is granted for water from the Horizon View wellfield
- two regimes of supply HGL are reflected – "Normal Low" →HGL 650, and "Minimum HGL" →HGL 535
- friction losses in the 8" and 10" connecting transmission line as well as PRV settings and supply HGL hydraulically limit the capacity of this intertie to supply the LFPWD network as follows:

Source Condition	Destination Condition	Capacity
Tolt HGL = 650 ft "Normal Low"	High Zone (452) 2-1/2" PRV at 187th St. opens at HGL 443	300 gpm
Tolt HGL = 650 ft "Normal Low"	High Zone (452) – 8" PRV at 187th St. opens at HGL 425	1,250 gpm
Tolt HGL = 650 ft = "Normal Low"	Low Zone HGL 294 (Horizon →Low zone PRV needed at McKinnon Cr. Facility)	2,150 gpm
Tolt HGL = 535 ft "Minimum HGL"	Low Zone HGL 294 (Horizon →Low zone PRV needed at McKinnon Cr. facility)	2,000 gpm

The District also maintains a two-way intertie with Northshore Utility District at the McKinnon Creek wellfield. Some relevant information about the NUD intertie is summarized here:

- was constructed jointly with NUD in the 1980's when LFPWD sold water to NUD for several years
- is located in an underground vault and also contains major junction box for underground feeders to well pumps
- facility is considered in fair condition and is not expected to require substantial improvements over the planning period.
- is a metered standby or emergency source and is functional. There is an intertie agreement but the intertie is not presently recognized by WSDOH for fire reserve because NUD does not budget fire reserve storage for the intertie in their Comprehensive Water System Plan.
- was tested in 2014 and found to convey 500 gpm sustained into the High zone (downstream PRV HGL 430) through a 4" pressure reducing valve in the underground vault.
- the intertie is bi-directional and can also lift water into the NUD system with duplex 5hp pumps
- controls for this pumping station will be re-located as part of the transfer pumphouse project.

WATER QUALITY AND TREATMENT

This section discusses the policies, standards, operation and deficiencies in the District relating to water quality. Included is an abridged copy of the District's 2014 Consumer Confidence Report (CCR) which describes general status of water quality. A complete copy of the current CCR appears in Appendix 3-C.

(a) Performance Standards

- All system design to meet standards of Good Engineering Practice and DOH guidelines as outlined in DOH "Water System Design Manual", dated 12/2009, DOH #331-123.
- District will prioritize source protection by
    1. control of wellhead protection areas and;
    2. community education as a means of preventing water quality degradation
- District will endeavor to continue its tradition of providing "naturally pure" water by creative solutions that assure the quality of water in its well sources, reservoirs and distribution system without the addition of chemicals in normal operation.

(b) Report of Water Quality – Abridged from the 2014 Consumer Confidence Report mailed to Customers in June 2015.

The State Department of Health and the EPA require water purveyors to sample their water on a regular basis to ensure its safety. The Department of Health (DOH) establishes specific testing requirements for each water purveyor, based on their risk assessment for each contaminant. Because of this, many tests are infrequent for reason of economy. Our District is required to test for bacterial contamination three times per month. To insure high quality water the District actually averages 15 bacterial tests per month.

Our water is not chlorinated or fluoridated. Families with growing children may contact their dentist regarding the use of fluoride supplements such as toothpaste containing fluoride. The District water is tested for arsenic in accordance with federal guidelines and levels remain within these standards. Some people are more vulnerable to contaminants in drinking water than the general population. Immuno-compromised people such as those undergoing chemotherapy, people who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice from their health care providers about drinking water. EPA/CDC guidelines on appropriate means to lessen the risk of infection by microbial contaminates are available from the Safe Drinking Water Hotline (1-800-426-4791). Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. State and Federal guidelines have suggested a Maximum Contaminant Level (MCL) for most substances found in water.

Table 3-5 (below) compares the detected values with the MCL for current test results. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791). The Total Coliform Rule (TCR) requires water systems to meet a strict limit for coliform bacteria all the way to the customer connection. Coliforms are a large class of bacteria that are mostly harmless, but their presence in water can be an indication of disease-causing bacteria. If coliform bacteria are found, special follow-up tests are done to determine if harmful bacteria are also present in the water supply.

	Violation Y/N	Last Sample In Period	Average Value	Maximum Value	Unit of Measurement	MCLG	MCL	Likely Source of Contamination
Microbiological/Physical Contaminants								
Coliform Bact	Y	12/15/2014	0.000	**2.00**	per 100/ml	0	**+/-**	May indicate exposure to pathogens
Fecal coliform and E.coli	N	12/5/2012	0.000	**0.00**		0	**0**	Human and animal fecal waste
Turbidity	Y	6/2/2010	1.390	**1.39**	NTU	n/a	**1**	Suspened Mineral deposits
Radioactive Contaminants								
Beta/photon emitters	N	6/9/2009	1.892	4.40	pCi/L	0	50	Decay of natural and man-made deposits
Inorganic Contaminants								
Arsenic	N	6/2/2010	4.000	**4.000**	ppb	n/a	**10**	Erosion of natural deposits; runoff from orchards; runoff from glass and electronics production wastes
Barium	N	6/2/2010	0.004	**0.004**	ppm	2	**2**	refineries; erosion of natural deposits
Copper	N	6/2/2010	ND	**ND**	ppm	1.3	**1.3**	natural deposits; leaching from wood preservatives
Fluoride	N	6/2/2010	ND	**ND**	ppm	4	**4**	Erosion of natural deposits, water additive, discharge from fertilizer and aluminum factories
Iron	N	6/2/2010	0.150	**0.150**	ppm	0.3	**0.3**	natural deposits in ground
Lead	N	6/2/2010	ND	**ND**	ppb	0	**15**	Corrosion of household plumbing systems
Mercury (inorganic)	N	6/2/2010	0.000	**0.000**	ppb	2	**2**	factories; runoff from landfills; runoff from cropland
Copper	N	6/2/2010	0.000	**0.000**	ppm	0	**1.3**	Corrosion of household plumbing systems
Nitrate	N	7/24/2014	1.230	**2.870**	ppm	10	**10**	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion
Source: raid-2\Water Quality\CCR\CCR.XLS								

Table 3-5 Water Quality Testing Results

\\Raid\raid-2\Water Quality\CCR\CCR.xls – Excel

Lead and copper monitoring is conducted as directed by the State in ten homes categorized as high risk. The District tests these homes under worst-case conditions. 2014 test results did not exceeded the 90th percentile allowable level for lead or copper. **Table 3-6** summarizes these results. In Washington State, lead in drinking water comes primarily from materials and components used in household plumbing. The more time water has been sitting in pipes, the more dissolved metals, such as lead, it may contain. Elevated levels of lead can cause serious health problems, especially in pregnant women and young children.

Variable	Contaminant Level (90% samples below this level)	Number of Sites Exceeding Action Level (AL)	Maximum Contaminant Level (MCL) / Action Level (AL)	Contamination Source
Copper	0.596 ppm	All Sample results below AL	Exceeds if >10% of homes tested >1.3ppm	Corrosion of household plumbing systems
Lead	6 ppb	All Sample results below AL	Exceeds if >10% of homes tested > 15ppb	Corrosion of household plumbing systems

Table 3-6 Lead and Copper Sampling

\\Raid\raid-2\Water Quality\CCR\CCR.xls – Excel

(c) Assessment of Observed Water Quality Concerns and Corrective Action

The available data show that the District's well water is of excellent quality. However there are a few concerns which are under review and action by the District. Historical water quality records are included in **Appendix 3-C** for reference.

- **Detectable amounts of Nitrates** in McKinnon artesian well water appear to have stabilized after a relative maximum in 2002. (see **Fig. 3-3**). Nitrate levels remain well below the MCL of 10 mg/l and are still below the trigger level of 5 mg/l. However, nitrate data are being carefully monitored and the District is educating residents in the zone of contribution regarding nitrate sources and control by minimizing the use of commercial fertilizers.

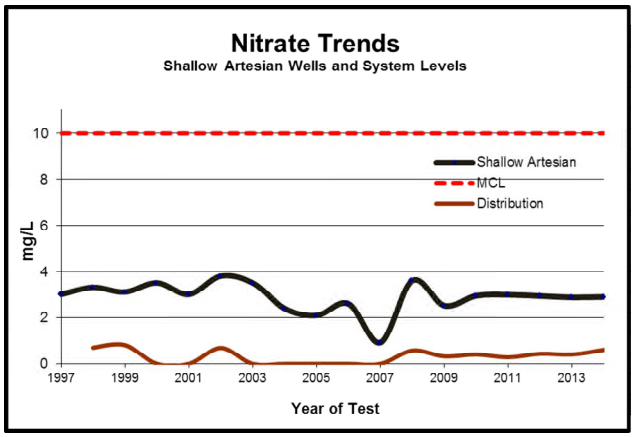


Figure 3-3 Nitrate Trends
\\Raid\raid-2\Water Quality\CCR\CCR.xls – Excel

- **High iron content in McKinnon Creek deep wells #3 and #4** as shown in **Figure 3-4**. Well #3 iron levels exceed the *Secondary* Maximum Contaminant Level of 0.3 mg/l set by the EPA and as defined in WAC 246-290-320. While iron levels in wells #3 and #4 are not a problem from a regulatory standpoint they would create a nuisance condition if not blended with water from other sources. Experience has shown an increase in customer complaints due to color/taste after peak season reliance on well #3.

The new McKinnon pump and control facility is being designed with capacity to install iron removal equipment. In the meantime, the District has modified pumping priorities to reduce reliance on well #3 during peak demand periods. Horizon View wellfield was used to supply a portion of peak demand during the summer of 2014 and with operational settings this can be further utilized for up to about half of the system peak daily demand with very little impact on pumping costs.

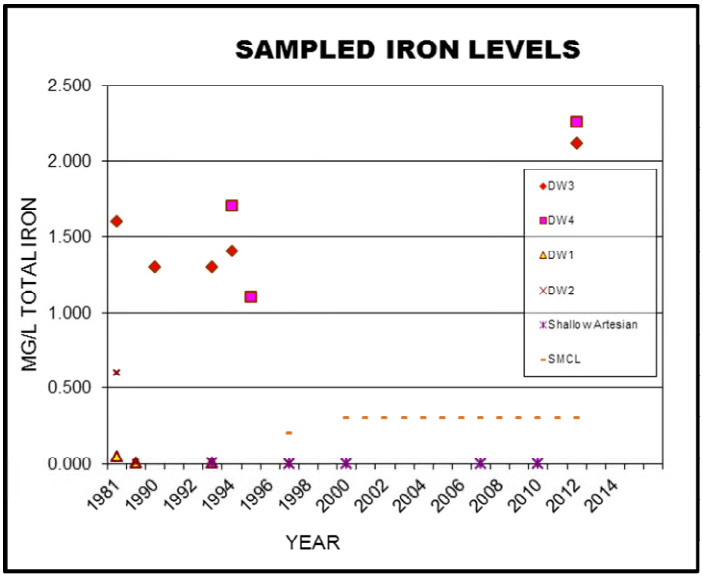


Figure 3-4 Sampled Iron Levels
\\Raid\raid-2\Water Quality\CCR\CCR.xls – Excel

- **Coliform Bacteria** have been detected in the distribution system on average about once per year since 2006. None of the exceedance samples have been attributed to the District's sources (wells) and none have shown acute (fecal coliform) contamination. The period of annual reoccurrence centers around late August – to early September (Average week #35) and it is believed that at least some of the problem is related to elevated water temperature in reservoirs.

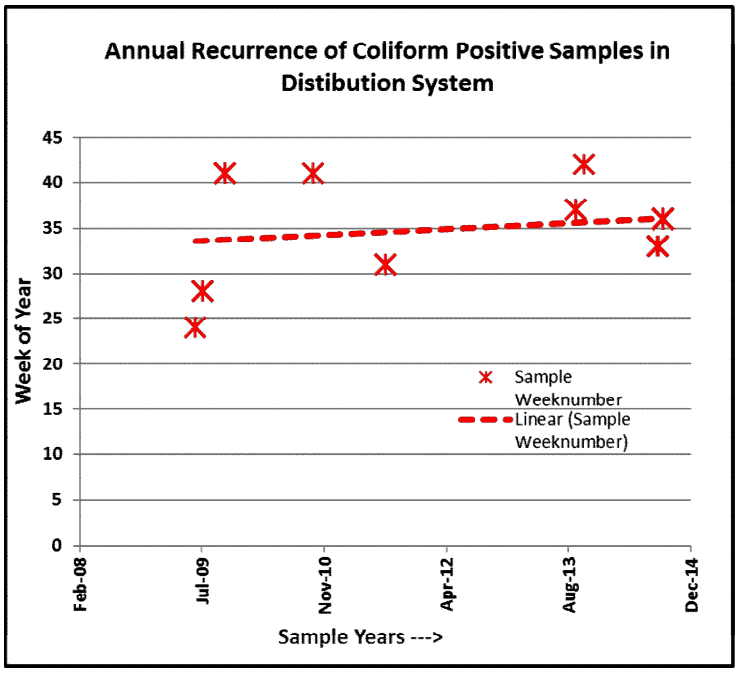
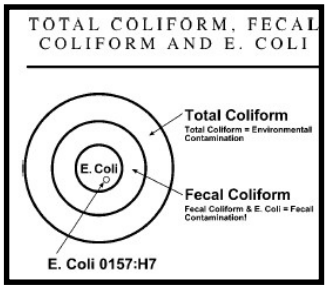


Figure 3-5 Annual Recurrence of Coliform Positive Samples
\\Raid\Raid-2\Water Quality\CCR\CCR2013.xls

In an effort to resolve this problem the District is implementing several capital improvements and discretionary BMP (Best Management Practice) measures including:

- Installation of mixing manifolds in reservoirs and upgrades to improve reservoir screening and hatch seals (complete)
- New and improved sample stations (complete)
- Scheduled and unscheduled water main flushing (on-going).
- Cleaning and disinfection of distribution reservoirs on regular basis. (At least once every five years).
- Improvements to coliform monitoring plan to ensure integrity and repeatability of testing (complete)
- Provision for temperature monitoring of reservoir plenum (planned)
- Over-flow "skimming" of reservoirs as a precaution during elevated risk periods (on-going)
- Spot disinfection of reservoir hatch and hatch seals whenever accessed
- Painting the top of reservoirs white to better reflect solar irradiation and reduce heat in the reservoir plenum (planned).
- Aeration bubblers with venturi stack to promote mixing (under consideration)

Washington State Department of Health is considering changes to monitoring and reporting requirements that would lessen the impact of total coliform presence as an indicator of pathogens. Total coliform testing is a broad indicator of bacteria found in the environment that are generally harmless. E. Coli can more specifically indicate the risk of a pathogen in drinking water (see inset graphic).



STORAGE DISTRIBUTION RESERVOIRS

This section outlines District policy and performance standards relative to distribution storage facilities, and discusses the operations and conditions relative to those policies and standards.

(a) Design and Performance Standards

- All systems designed to meet Good Engineering Practice and DOH guidelines as outlined in DOH "Water System Design Manual", dated June 1999, DOH #331-123.
- Equalizing storage will be above a level that assures 30 psi at Peak Hourly Demand.
- Future storage will be sited to minimize fluctuations in system pressure and to maximize availability to firefighting demands.
- District will endeavor to meet Insurers Services Organization (ISO) flow and duration requirements for new construction, while ISO requirements of older construction, particularly commercial and institutional buildings, may not be met.
- District will endeavor to maintain sufficient fire suppression storage to meet the requirements of MDD (Maximum Day Demand) with sufficient capacity to supply required fire flow in conjunction with intertie water.
- District will endeavor to maintain sufficient standby storage to provide at least 200 gallons per ERU for each independent zone.
- District will construct new storage facilities to meet current seismic design standards for the local area. Siting and construction will be sensitive to safety and aesthetic value.
- All reservoirs will include either alarm or telemetry, capable of notifying operators of overflows or when storage level drops below normal operational levels.

(b) Distribution Storage Capacity Overview

The District has four water storage facilities totaling about 515,000 gallons. **Table 3-7** summarizes the physical information for the District's reservoirs. Washington Department of Health (WSDOH) has established capacity standards for distribution storage (Water System Design Manual 2009 Chapter 5. Distribution storage capacities in the District are compared with WSDOH standards for each pressure zone here:

Storage Balace Summary by Pressure Zone

WSDOH Standard	"Horizon" Zone TWL 569 ft	"High"Zone TWL 452 and "Intermediate" Zone	"Low" Zone TWL 295 and "Beach" Zone
	(0 ERU in 2015, future expect 60 ERU)	**(563 ERU in 2015)**	**(437 ERU in 2015)**
Redundancy – more than one tank or storage option	SPU Intertie provides redundancy	SPU Intertie provides redundancy to the 200,000 gal steel standpipe reservoir.	12,000 gal standby tank + SPU intertie provide redundancy to the 250,000 gal reservoir.
Telemetry/SCADA system with automatic notifications	YES	YES	YES
Standby Storage (SB) 200 gallons per ERU	WSDOH standard 12,000 gallons. Available storage = 32,151 gallons + SPU intertie	WSDOH standard 112,600 gallons. Available storage = 185,157 gallons + SPU intertie	WSDOH standard 87,400 gallons. Available storage = 227,523 gallons + SPU intertie
Fire Supression Storage (FSS)	Residential structure fire 1,000 gpm x 2 hours = 120,000 gallons. Available = 32,151 gallons + SPU intertie and source production during fire.	Commercial facility fire at School 3,000 gpm x 3hours = 540,000 gallons. Available storage = 57,753 gallons + SPU intertie and source production during fire.	Commercial facility fire at LFP Town Center 3,500 gpm x 3 hours = 630,000 gallons. Available storage = 227,523 gallons + SPU intertie and source production during fire.
Equalizing Storage (ES)	Source capacity exceeds peak hour demands with largest source out of service.	Source capacity exceeds peak hour demands with largest source out of service.	Source capacity exceeds peak hour demands with largest source out of service.

file: Raid-2\Reservoirs\Summary Reservoir Information.xls
edit date: July 23, 2015

Reservoir Physical Information

Facility	Units	Steel Standpipe	Lower Reservoir	Horizon View Eq. tank	Standby Transfer Tank	
Year Built		1963	1967	2012	2002	Total
Base Elev.	ft	397.57	271.53	555.00	280.47	N/A
Height of Tank (Base to Roof)	ft	56.00	24.00	16.00	15.09	N/A
Diameter	ft	24.50	42.23	24.00	12.00	N/A
Construction		Welded steel	Welded steel	Welded steel	crosslinked HDPE	N/A
Overflow Water Level (elevation)	ft			569.90	301.12	N/A
Top Water Level (TWL) shutoff setting (elev)	ft	452.57	295.57	569.30	295.57	N/A
Pump "ON" Water Elevation	ft	450.57	292.57	565.00	292.57	N/A
Minimum Water Elevation for 30 psi service pressure under peak hour demand (from network hydraulic model, "as is" conditions)	ft	424.57	252.57	555.50	252.57	N/A
Effective Minimum Water Elevation for 30 psi peak hour demand		424.57	271.53	555.50	280.47	N/A
Minimum Water Elevation for 20 psi service during Max Day + Fire Flow of 1000 gpm (from network hydraulic model, "as is" conditions)	ft	434.20	271.53	555.50	280.47	N/A
Minimum Water Elevation to maintain 20 psi service for standby during Max. Day flow conditions	ft	397.57				N/A
Dead Storage Depth for min 20 psi at Avg. Day	ft	0.50	0.25	0.50	0.66	N/A
Capacity per foot	gal/ft	3527	10478	3384	846	N/A
Tank Volume (calculated)	gal	197501.03	251479.49	54149.15	12770.88	**515900**
Tank Capacity to TWL	gal	193974.23	251898.62	48395.80	12775.81	**507040**
Operational Storage (OS)	gal	7053.61	31434.94	14552.58	2538.24	**55580**
Dead Storage Volume (DS)	gal	1763.40	2619.58	1692.16	558.41	**6630**
Effective Storage Capacity for min 30 psi service	gal	89933.50	217844.11	30458.90	9679.16	**347920**
Fire Supression Storage (FSS) Capacity for min 20 psi residual pressure at Max Day	gal	57733.78	217844.11	32151.06	9679.16	**317410**
Standby Storage (SB) capacity for min 20 psi at Avg. Day {nested with FSS}	gal	185157	217844	32151	9679	**444830**
Exterior coating date		2010	2004	2012	N/A	N/A
Interior coating date		2010	2003	2012	N/A	N/A
Construction		Welded steel	Welded steel	Welded steel	crosslinked HDPE	
Notes		Upgraded w/ mixing manifold and nozzles in 2010	Upgraded w/ inlet stack 2003	Mixing manifold horizontal with nozzles	no mixing	
E:\Reservoirs\Summary Reservoir Information.XLS						
Note: Elevations are in NAVD88. (NAVD88=NGVD29+3.57ft)	3.57					
Edit: Feb. 11, 2015						

Table 3-7 Reservoir Physical Information

\\Raid\raid-2\Reservoirs\Summary Reservoir Information.xls – Excel

Besides its own storage the District also relies on an intertie with Seattle (Tolt) pipeline on 195th Street for emergency use including fire protection. There is also an intertie with Northshore Utility District in the McKinnon Creek well field.

(c) Condition and Performance Evaluation

High Zone Steel Standpipe - A 200,000 gallon welded steel standpipe supplies the High zone, (HGL 452), and the intermediate zone, (HGL 330) through PRV's. In an extreme demand situation the tank will also supply water to the low zone, 292 feet, and the beach zone, 226feet through pressure reducing valves. The tank is in good apparent condition following refurbishment in 2010 which included:

- resurfacing of the interior and exterior
- installation of an internal mixing manifold with nozzles to improve water quality.
- platform for wireless telemetry equipment was also installed on the reservoir roof at the same time.

This reservoir was fitted with a corrosion control anode and footing cap in 2005 to control corrosion of the "chine" or steel plate resting on the concrete footing. There are questions about the seismic stability of the standpipe and the underlying ground. A seismic review is scheduled in the Capital Improvement Plan.

Low Zone Reservoir The 250,000 gallon welded steel Low Zone reservoir is operational and in good apparent condition. The interior was last re-surfaced in 2003 and the exterior in 2004. A new inlet pipe and HDPE mixing manifold (without nozzles) was installed at the same time. This reservoir was fitted with a corrosion control anode and footing cap in 2005 to reduce corrosion of the "chine" or steel plate resting on the concrete footing. There has not been a seismic evaluation of this reservoir and this will be completed as part of the Capital Improvement Program.

Low Zone Standby A 12,000 gallon HDPE emergency standby equalizing storage tank was installed which allows the District to use their own water during repairs and maintenance of the lower reservoir, offsetting the cost of outside water purchases. This reservoir is in excellent condition.

Horizon View Zone Equalizing A 50,000 gallon welded steel tank receives water from Horizon View wells and supplies to the Distribution system. There is a PRV at 187th / 46th Ave. which admits this water to the High Zone by timer control (50gpm, 12hrs) and by falling gradient in High Zone. This reservoir was constructed in 2013 and is in excellent condition.

DISTRIBUTION

The distribution system includes water mains, valves, pressure reducing and relief valves, fire hydrants, and services. This section summarizes the District's design and performance standards for distribution works and then describes their operation and status. Findings of a detailed hydraulic analysis follow in a subsequent section.

(a) Design and Performance Standards

All system facilities designed to meet Good Engineering Practice and DOH guidelines as outlined in DOH "Water System Design Manual", dated June 1999, DOH #331-123. Fire flows shall at a minimum meet the current ISO fire flow schedule or as directed by the local Fire Marshall.

Distribution System Performance Criteria summary:

Pressure Related:

- Maximum desirable service pressure at 120 psi under static conditions.
- Minimum desirable service pressure at 30 psi at peak hourly demand.
- Minimum residual service pressure at 20 psi during maximum day demand plus fire flow.
- Customers are responsible for reducing pressures that are above 80 psi at service point.
- Minimum water main pressure under any event is 5 psi except for transmission mains adjacent to reservoirs.

***Flow Related*:**

- Minimum available fire flow for residential construction shall be 1,000 gpm at maximum day flow, duration 2 hours. Commercial fire flow shall be as established by the local Fire Marshall.
- Maximum velocity eight feet per second at maximum day, preferably under peak hour.
- Minimum flushing velocity of 2.5 feet per second for all mains.

***PRV Design and Performance Criteria*:**

- Shall be designed with parallel valves to be able to safely carry required minimum and maximum flows without valve needling or hydraulic head loss.
- Shall include pressure relief capable of limiting downstream pressure increase to less than 25 psi in the event of valve failure.
- Shall be housed in suitable precast chambers with approved load bearing, access hatch, ventilation and drainage systems.
- Shall have pressure sustaining function as directed by engineer.
- Shall be equipped with internal or external flow metering.
- Shall have adequate provision to maintain circulation in looped portions of the network
- Shall be designed with compact, gear operated butterfly valves using stainless steel or approved oven baked epoxy enamel coated steel piping.
- Shall include support stantions and groove lock (Victaulic) joints in piping for easy removal of key components

Water Main Design Criteria:

- Loop all new mains for redundancy and water circulation.
- Mains not serving fire hydrants sized for customer demand only to avoid stagnation.
- Eight inch minimum diameter for all mains serving fire hydrants excepting hydrant laterals 6" minimum diameter.
- Valve spacing in new water main design not to exceed 350 feet; minimum three valves per cross, and two valves per tee including fire hydrant lateral connections.
- Air/vacuum release valves to be placed at all high points
- Cover depth at three foot minimum, all pipe to be buried with 14 gauge tracer wire for radio location.
- Joint restraint extending a minimum 40 feet or 3 joints from fittings is required for sleeved ductile iron pipe.
- Pipe construction: sleeved ductile iron for sizes six inch or over; 200 psi polyethylene or PVC for smaller size mains not serving fire hydrants. High Density Polyethylene (HDPE) is suitable for transmission mains, undeveloped areas and for 4" or smaller diameter.
- Predicted service life must exceed 50 years for any new pipe installation.

Fire Hydrant Design Criteria:

- Fire hydrant spacing in all new construction is not to exceed 700 feet with no more than 350 feet to the farthest property line.
- Commercial and multi-family areas, fire flow less than 2,500 gpm. 400 feet maximum between hydrants. All buildings within 300 feet of one hydrant, or as required by Fire Marshall.
- High fire flow areas, greater than 2,500 gpm. One accessible fire hydrant for each 1,250 gpm of required flow within 150 feet of building. One additional accessible fire hydrant for each 1,250 gpm within 450 feet of building. Buildings having required fire flows of less than 2,000 gpm may have fire hydrants on one side of the building only. When the required fire flow is over 2,500 gpm, the fire hydrants shall be served by a main which loops around the building or complex of buildings and reconnects back into the distribution main.
- All hydrants are to be accessible to fire department pumpers and over roads capable of supporting such fire apparatus. The Fire Marshall shall determine the location of the fire hydrants depending on utility, topography and building location.

Service Connection Design Criteria:

- Service meters will be replaced on a periodic basis which may coincide with manufacturer's warranty, or may be extended up to 50% based on test sampling of meters removed from service.
- New service lines will be constructed of 200 psi class polyethylene and will have an attached tracer wire with termination in valve boxes for easy location.
- It is the customer's responsibility to provide internal pressure relief. The District will notify all existing customers in advance if a check valve is to be installed in their service.

- Connection Sizes

a. The size of a service connection and meter shall be determined by the required flow and shall not be less than the following (sizing for larger capacities shall be made by the District engineer):

Size of		Water Pressure (PSI)							
Water	Service	30	35	40	45	50	55	60	65
Meter	Line	Gallons Per Minute (GPM)							
5/8"	3/4"	5.3	7.5	10.5	12.8	14.3	15.0	16.5	17.3
3/4"	3/4"	7.5	10.5	12.0	13.5	16.5	18.0	21.0	22.5
3/4"	1"	11.3	15.0	17.3	20.3	22.5	24.0	26.3	27.8
1"	3/4"	9.0	11.3	13.5	15.0	18.0	19.5	22.5	24.0
1"	1"	13.5	18.0	20.3	25.5	28.5	30.0	31.5	31.5

Table 3-8 Water Service Size and Flow

b. All multiple unit residences, apartments, manufactured home parks, and motels shall be serviced by one connection and one meter, except that the owner may elect to treat each unit as a separate single residence and in such case there shall be installed an individual meter for each unit at the owner's expense.

c. The pipe size for a service connection shall not be less than the size of the meter as set forth in the water application. At the discretion of the District, larger pipes may be installed to provide water to more than one meter from a single connection, provided such single pipe installation results in an appreciable savings in the total installation costs.

The above items are summarized design standards for the network. Detailed construction standards are delineated in Part Seven of this document.

(b) General Description and Condition of Distribution System

The District's distribution system includes over 13 miles of looping and dead end transmission and distribution mains ranging in size from two inch to twelve inch that convey water by gravity from the Horizon View (HGL 569) and from the High Zone (HGL 449) and Low Zone (HGL 292) reservoirs. **Figure 3-6** is a map of the existing network which illustrates the layout, pressure zones, pipe material and size along with valves and fire hydrants. The mains serve 891 service meters and 106 fire hydrants over terrain ranging from a low elevation of 20 feet near Lake Washington up to 350 feet in the north end of the District on 51st Place NE. There are also 71 lots that are presently served by NUD and NCWD but are within District legal boundaries. The highest service elevation of these lots is over 430 feet but within the service elevation of the Horizon View (HGL569) pressure zone.

Figure 3-6 Water Network Map Existing (2014)

\Raid\raid-2\WD83MAP\WD83MAP.dwg

LAKE FOREST PARK WATER DISTRICT

FIGURE 3-6
PHYSICAL NETWORK
PIPE SIZE, MATERIAL, VALVES, FIRE HYDRANTS

Legend

- Water Meters
- Service Line
- Address Leader
- Line Valve & Number
- Line Valve Closed

Fire Hydrants 2014

- 700-1000GPM
- 1000-2000GPM
- 2000-2500GPM
- 2500GPM+

Pipe Material

- Asbestos Cement
- Cast iron
- Ductile Iron
- Galvanized iron
- HDPE
- PVC
- Steel

Pressure Zones

- High Zone
- Intermediate Zone
- Low Zone
- Beach Zone

Contours

- 20
- 100

Boundaries

- Lake Forest Park Water District
- North City Water District
- Property Parcel
- Right of Way
- city
- Street
- Water Course
- Water Body
- Wellfields
- Parks

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

MUNDALL ENGINEERING & CONSULTING

P.O. Box 799
Sumas, Washington 98295

P.O. Box 56
Lytton, B.C. V0K 1Z0

Toll Free
1-800-313-9705

Bus. (250) 455-0085
FAX (250) 455-2276

Cellular (360) 319-1285
E-Mail DanM@Mundall.com

Water System: January 2016
Parcels, Streets, Right of Way, Elevation Contours, Water Features, and Political Boundaries from King County GIS, May 2015

This map is based on best available data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

NAD_1983_HARN_StatePlane_Washington_North_FIPS_4601_Feet
PSLC: Lidar 2016

MAP DATE: August 2016

0 250 500 1,000 1,500 2,000 Feet

N W E S

(c) Water Network Piping

Table 3-9 summarizes size, material of construction and age of transmission and distribution piping in the District's network as of 2014. This Table was constructed with data from the network model.

PIPE BREAKDOWN BY SIZE, MATERIAL and AGE

Pipe Material, ft	1"	2"	4"	6"	8"	9"	10"	12"	14"	All Dia., ft	All Dia., %	Expected Service life, years	Average Age in System, years	Average Remaining Years	Average % Usable Life Remaining
Asbestos Cement	0	0	0	2,230	1,819	0	0	0	0	4,049	5.7%	65	45	20	31%
Cast iron	0	0	0	122	0	0	0	0	0	122	0.2%	100	55	45	45%
Ductile Iron	0	10	10	807	38,015	0	2,452	4,643	1	45,936	64.7%	100	18	82	82%
Galvanized iron	235	2,840	0	0	0	0	0	0	0	3,075	4.3%	50	65	0	0%
HDPE	0	1,227	0	0	2,053	1	0	0	8	3,289	4.6%	100	6	94	94%
PVC	0	127	35	429	1,817	0	0	0	0	2,407	3.4%	85	35	50	59%
Steel	0	0	0	11,908	217	0	24	0	0	12,149	17.1%	50	62	0	0%
All Materials, ft	235	4,204	45	15,495	43,920	1	2,476	4,643	9	71,025	100.0%				
All Materials %	0.3%	5.9%	0.1%	21.8%	61.8%	0.0%	3.5%	6.5%	0.0%	100.0%					

raid 2:\inventory\Pipe Inventory.xls

Table 3-9 Existing Pipe Inventory
\\Raid\raid-2\Inventory\Pipe Inventory.xls – Excel

The original network constructed between 1910 and the 1930's was constructed of small diameter black iron steel along with creosote coated wood stave pipe. In the 1950's these were mostly replaced with hot dipped and coupled thin wall steel pipe 4" and 6" diameter. Small quantities of Asbestos Cement, Cast Iron and PVC were installed over the next 30 years. In the late 1980's the District began the process of replacing the now aging steel with coated, sleeved ductile iron piping. This process is on-going and will continue until all steel and galvanized iron pipe is replaced. Asbestos cement, PVC and Cast Iron pipe is also being replaced but with lower priority. New pipe is either coated and sleeved ductile iron or polyethylene pipe. Pipe failures are logged by the District. Data show a marked increase in failures of steel pipe per 1000 ft in the past 10 years. **Figure 3-7** illustrates this trend graphically. Currently about 7 - 10 failures per year are generated by about 12,000 feet of thin wall steel pipe. The average failure rate is about 0.60 per 1000 feet at present. Fortunately pipe replacements are keeping the overall number of failures fairly constant but given the exponential increase per 1000 feet the overall failures per year would likely increase if pipe replacements were discontinued for several years. A map showing main repairs over the past 10 years is shown in **Appendix 3-K** for reference.

Pipe replacements are prioritized by six factors in general order of priority shown here:

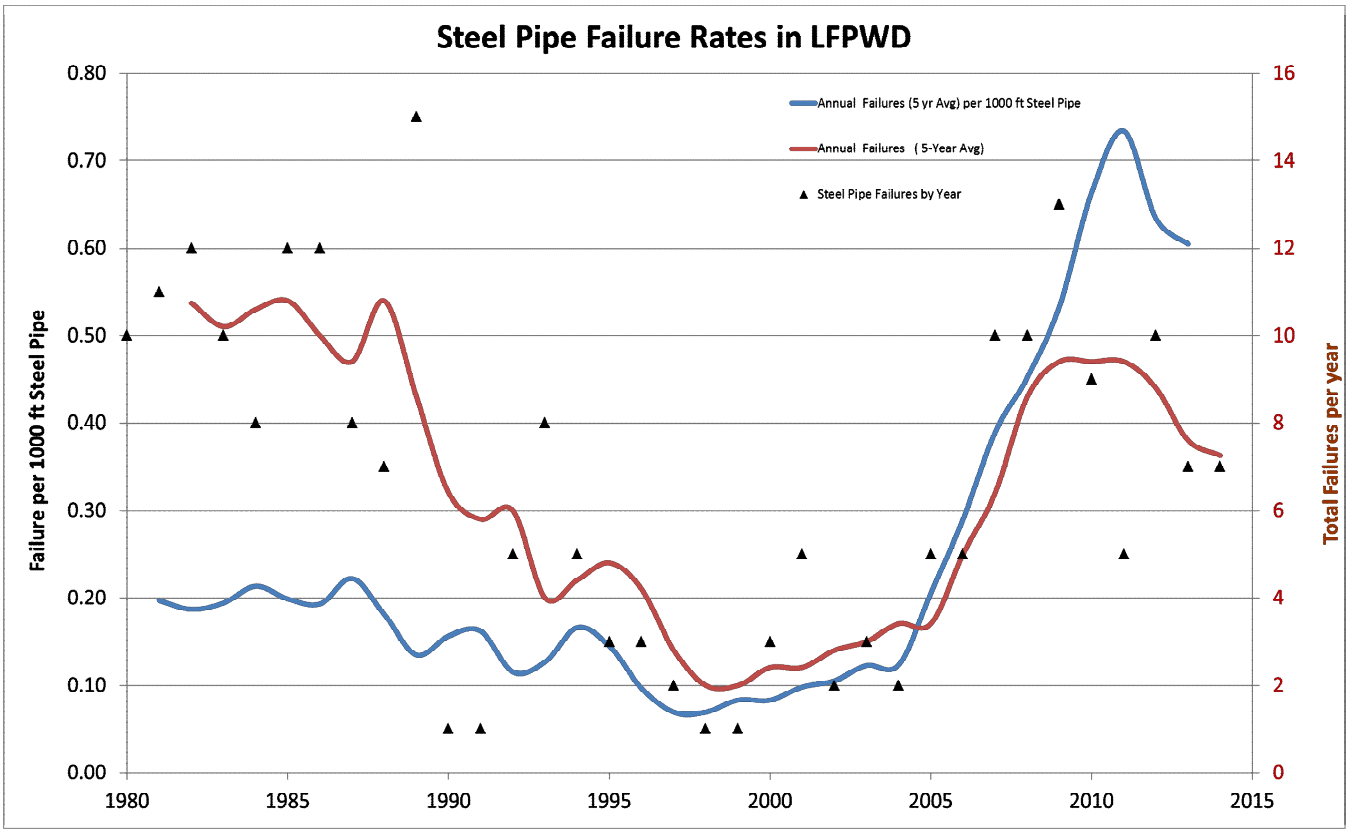


Figure 3-7 Steel Pipe Failure Rates

Raid2://Inventory/Leaks.xls - Excel

1. ***Pipe failure frequency***. Pipe failures are recorded and charted to identify trouble spots where electrolysis corrosion is particularly severe and failures are very high. The entire network has been prioritized by the number of pipe failures per 1000 ft/year. Maintenance crews occasionally replace limited sections of main if they show a record of failures. Note that failures can present a risk of erosion damage and water contamination.
2. ***Impact of Failure***. In some areas pipes are under highly trafficked state highway and present unusual risk and cost of repair. These are accorded a higher priority than areas where impact is lower.
3. ***Funding availability*** and priorities of funding sources.
4. ***Coordination with outside factors*** including the City of Lake Forest Park comprehensive road surfacing program. This is especially critical where pipe installation would require open cut trenching in the traveled road.
5. ***Hydraulic capacity*** and its impact on providing domestic and fire flow in accordance with standards such as the state and local fire district requirement of 1,000 gpm with 20 psi residual at maximum day flow. Over the past decade network hydraulic capacity has been improved significantly by several infrastructure project so hydraulic capacity is a lower priority overall.
6. ***Project grouping*** for economy of scale. It is desirable to complete entire street sections in a single project. However, capital funding limitations require prioritization of smaller sections with the highest frequency of failure.

(d) Pressure Reducing Valves (PRV)

The varied topography of Lake Forest Park requires segregation of supply and distribution piping into pressure zones. There are 5 pressure zones in the District that are separated by a total of 8 PRV (Pressure Reducing Valve) stations. Additionally there are PRV stations to control water admitted from interconnections with higher pressure – such as Seattle Tolt intertie on 195th Street and NUD intertie in the McKinnon Creek watershed. **Table 3-10** summarizes existing PRV information by individual valve. All recently constructed PRV stations have also been equipped with relief valves in case of valve malfunction.

Pressure Reducing Valves have excellent reliability over many decades given periodic maintenance. Valves are set with pressure differential lead/lag (low flow/high flow) pairs in each station. Parallel stations are also set with small pressure differences between stations to encourage circulation in the entire network and to eliminate dead zones. Recently constructed PRV stations have been equipped with small timer override valves to guarantee circulation.

Condition: One of the existing PRV stations (#5084 178th St.) is considered to have reached end of service life and will be replaced over the planning period. Other existing stations are in serviceable condition.

A need for additional PRV stations is foreseen over the 20 year planning horizon as follows:

Location	Size/function	Purpose
McKinnon Cr. WHPA new pumping facility	10" PRV admit water from Horizon View zone to Low Zone	Supplement fire flow to Low zone commercial (LFP Towne Ctr.)
#5084 178th Street	8"x2"x4" PRV/relief chamber	Replace existing aging PRV
Ballinger (SR104) /37th Ave. w/ reverse check bypass	6" x2" x4" PRV/relief w/ bypass	Improve fire flow, allow reverse flow to LFP Elementary for fire
Ballinger (SR104) /40th Ave. w/ reverse check bypass	6" x2" x4" PRV/relief w/ bypass	Improve fire flow, improve circulation
47th Ave./184th Street	6"x2"x4" PRV/relief	Improve fire flow, improve circulation
#3020 180th Street	6"x2"x4" PRV/relief	Improve fire flow, improve circulation
#18517 53rd Ave.	6"x2"x4" PRV/relief	Pending NUD customer service agreement
#17124 Beach Dr.	6"x2"x4" PRV/relief	Beach zone redundant loop improve fire flow
#17425 Ballinger (SR104)	1.5" PRV/Timer Bypass	Ensure adequate circulation in 12" DI that is dead end at present.

Pressure Reducing Valve (PRV) Summary Information

Site Address	19431 NE 195th St.		18704 187th Street				3753 N.E. 188th St.			3844 185th Street			5084 178th St.		3520 N.E. 182 St.	WHPA	17430 Ballinger Way - Beach		
Location Description	East shoulder 46th Ave near 195th St.		South shoulder unopened ROW Near int. 46th Ave.				South shoulder nr. end of street			nr. End of street - School			North Shoulder		East shoulder	West shoulder of rd.	East shoulder near int. 175th Street		
Network Model ID	PRV-4		PRV-5				PRV-3			PRV-154			PRV-40		PRV-150	NUD Intertie	PRV-72		
PRV Size inches	4	10	2.5	8	4" Surge Relief	4" DS Relief	2	6	3	2	6	3	1.5	4	4	4	2	6	3" Relief
Valve Make	Cla-Val	Cla-Val	Cla-Val	Cla-Val	APCO	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val	Cla-Val
Valve Model	92-01BCDV	90G-28ABS	90-01BCSY	90-01BCSY	3004.2	50-01B	90-01	90-01	50A-01	90-01	90-01	50A-01	90G-01AJ	90G-04AB	90G-01AB		90-01BCSVY	90-01BCSVYKX	50-01BV
Valve Serial #	92-01-2115F-E2	90-287H	90-01-7766K-B3	90-01-5990H-B3		50-01-162F-B2							76597-02	76732-02			90-01-11039E	27490651E	50-01-5085E
CRD Model													71943-04	71943-04					
CRD Spring	15-75	15-75	15-75	15-75	15-75		20-105	20-105	20-200	20-105	20-105	20-200	15-75	20-300					
Operating Priority	1	2	1	2			1	2		1	2		1	2	1	1	1	2	
Hydraulic Grade, Inlet, Static	650	650	569	569	569		452	452	342.6	452	452	343.1	452	452	342		294	294	
Observed Upstream Pressure, psi	60	60	115	115	115								115	115	85	NUD Zone	105	105	74
Downstream Zone	Horizon View	Horizon View	High	High	High	Atmosphere	Intermediate	Intermediate	Atmosphere	Intermediate	Intermediate	Atmosphere	Low	Low	Low	430.2	Beach	Beach	Atmosphere
Highest Elevation Served, ft	425		348				200			200			185				53		
Access Lid Elevation, ft (NAVD88)	512	512	310	310	310	310	209	209	209	168	168	168	188	188	143.6	262.26	56	56	56
Valve Elevation (c/l pipe), ft	507	507	305	305	307	305	204	204	205	163	163	164	185	185	140.6	257.01	50	50	52
DS Set Point, PSI	23	18	59.75	51.9	195	78	60	55	65	78	73	83	50	45	60	75	75	68	84
Date of last calibration	Jun-13	Jun-13	22-Jan-15	22-Jan-15	6-Jan-11	22-Jan-15	May-12	May-12		May-12	May-12		Jun-00	Jun-00	Jun-00	Oct-09	Oct-13	Apr-13	Apr-13
DS Set Point HGL, (calculated) ft H20	560.1	548.6	443.0	424.8	757.3	485.1	342.6	331.0	355.1	343.1	331.6	355.7	300.5	288.9	279.2	430.2	223.2	207.0	246.0
Elevation Datum	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NAVD88	NGVD29	NGVD29	NAVD88	NAVD88	NAVD88	NAVD88	
Date of Chamber Construction	Jul-11	Jul-11	Oct-10	Oct-10	Sep-11	Oct-10	Jul-11	Jul-11	Jul-11	Jul-11	Jul-11	Jul-11	1950's		1970's	1990's	April-13	April-13	April-13
Date of Valve Replace																			
Date of Last Major Repair	N/R	N/R	N/R	N/R	NR	N/R	N/R	N/R	N/R	N/R	N/R	N/R	Mar-15	N/R	N/R	N/R	N/R	N/R	
Chamber design/drainage	GC Systems precast underground vault, venturi ejector floor drain to storm C/B		Underground vault, precast panels, electric sump drain to surface				GC Systems precast underground vault, ejector drain to stream			GC Systems precast underground vault drain to daylight			Precast underground vault		Precast underground vault	Precast underground vault, drain to daylight (McKinnon Cr.)	GC Systems precast underground vault, ejector drain to C/B		
Notes	Auto timer flush to storm C/B daily 17gpm/3minutes@3AM		Auto timer flush bypass to High Zone 50gpm/12hours@6AM daily. High side APCO3000 surge relief with hydraulic damper. Flow meter in vault. APCO 3000 needs maint. Hyd. Oil change + set relief to 130-135 psi				Meter vault downstream			Meter vault upstream						Meter in PRV vault	Meter vault downstream		

file: e:\PRV's\Summary PRV Station Info.XLS
updated 8/31/2016

Table 3-10 Existing PRV Information
\\Raid\raid-2\PRVs\Summary PRV Station Info.xls – Excel

(e) Customer Service Connections

In addition to piping replacement, the District has an on-going program of customer meter replacement. Replacement priority is set by age. Computerized management of meter replacement history is maintained by the District. Meter records are used in servicing and replacement scheduling. After the initial replacement program is complete the District intends to annually replace approximately 50 meters, amounting to approximately five percent of the total. The actual replacement schedule will depend on the performance of meters removed from service. At the present time, manually read meters are being installed and there are no plans for electronic meter reading.

The District maintains approximately 875 water service lines with isolation valves and boxes. District policy is to use polyethylene service pipe in new service line construction, although many copper and galvanized services remain. There are no known lead based service lines in use in the District. Service lines are also mapped in the District's GIS.

(f) Fire Hydrants and Isolation Valves

Relevant information regarding District Fire Hydrants is offered here:

- District maintains over 106 fire hydrants and hydrant isolation valves of varying age, averaging around 35 years.
- Fire hydrants are inspected and maintained by the District.
- Hydrant replacement and status information is maintained in electronic and paper format.
- Nomenclature for fire hydrants is based on a combination of the street name and nearest street number. For instance: "178ST4420" refers to a hydrant near #4420 – 178th Street
- Most of the hydrants are made by Iowa, and about a third are made by Mueller.
- A few hydrants still have four and one half inch valves. These are gradually being replaced by five and one half inch models in conjunction with main replacements.

(g) Main Valves

The District operates and maintains over 100 line valves. Most of these are non-rising stem gate valves with two-inch turning nuts. Presently a valve record is maintained for each valve in hard copy form. The sample record is located in **Appendix 3-D**. The record includes valve location, size, type, identification number with detail, inspection dates and other fields.

II. HYDRAULIC MODELING AND REPORT

INTRODUCTION

The previous section analyzed the system from records, observation, inspection, records of life span, operating history, and performance data. This section describes the results of a hydraulic analysis of the existing supply and distribution system and the ability to meet peak demands caused by customer usage and fire suppression.

Water systems are expected to perform reliably under many scenarios that are not common to daily operation and it would be difficult if not impossible to carry out comprehensive field tests to confirm adequacy of design for these varied scenarios. Over the past several decades engineers have developed increasingly sophisticated computer modeling tools to predict the behavior of the various elements of a water system including pipes, pumps, reservoirs, regulating valves and fire hydrants. WAC 246-290 also requires hydraulic modeling as part of comprehensive water system plan preparation.

OBJECTIVES

1. To determine the adequacy of supply, storage and distribution infrastructure to meet District and WSDOH standards for performance under current and future conditions.
2. Evaluate water aging in supply and distribution network and identify areas requiring improvement.

WATER DISTRIBUTION SYSTEM MODEL

Hydraulic modeling was performed using Bentley WaterCAD V8 XM water modeling software. The current water model was originally constructed by Mundall Engineering in 1999. The model has periodically been refined to reflect new infrastructure and improved information about the system. Major updates to the model in this plan include:

- Addition of new infrastructure including:
    - new Horizon View Wellfield, reservoir and the SPU Intertie at 195th Street along with PRV station at 46th Ave/195th St. and PRV station at 46th Ave/187th Street (const. 2010 – 2013)
    - new redundant 10” transmission main between south McKinnon Creek wellfield and 43rd Ave. (const. 2010)
    - new redundant distribution main between 40th PL and 37th Ave. and PRV station on 188th Street
- Adjustment of size, material, and installation year to reflect system upgrades/replacements from numerous projects carried out since the previous system plan preparation in 2005.

- Update with more accurate information from physical inspection and mapping updates
- Define pump performance curves based on real-world performance
- Additional minor losses were added for pipe fittings in some complex piping arrangements and in pressure reducing valves.
- Development of a diurnal system demand curve based on operating history
- Set up various control parameters such as pump switch levels and PRV settings to more closely mimic actual operation

SYSTEM DEMANDS

The District is comprised primarily of single family residences with only about a dozen commercial establishments, most of which are in or close to the Lake Forest Park Town Center. Minimal growth is anticipated over the planning period and it would be expected in the following ways:

1) Limited infill development (25 lots)
2) Servicing of lots that are within the service boundary that are served by other districts (62 lots)
3) Possible construction of higher density housing in commercial areas including multi-purpose re-development of the LFP Towne center.

The following system are used in model scenarios for this plan and are based on growth projections discussed in Part II of this document.

Planning Scenario	Demand Flow Condition			
	Peak (max) Day + residential fire flow throughout service area GPM	Peak (max) Day 3500gpm fire flow	Peak Hour throughout service area GPM	Average Day GPM
2013-2014	538+1000=1538	538+3500=4038	800	182
2020	550+1000=1550	550+3500=4050	825	173
2025	556+1000=1556	556+3500=4056	831	169
2033	564+1000=1564	564+3500=4064	916	174

Table 3-11 System Demands for Hydraulic Model Scenarios

MODEL LAYOUT AND CONSTRUCTION

The District maintains a GIS mapping dataset in Autodesk Civil 3D that depicts its infrastructure and other important features. In this map, the Waternetwork layer records the best known location and type of pipe in the system. Originally the Waternetwork layer was constructed from various maps, as-built drawings and local knowledge of the system. Regular updates are made whenever more accurate locations are discovered, usually through field survey. The current Waternetwork layer was imported into WaterCad and used as the basis for all model adjustments.

Figure 3-8 depicts the existing water network model along with pipe and node numbers. Pipes are colored to correspond with each pressure zone including the new "Horizon View" zone. Tabular data representing each pipe and junction (node) are listed in **Appendix 3-E** for each planning scenario.

DEMAND DISTRIBUTION

To better account for realistic dynamic demands in the system, the network nodes were assigned **unit demands** representing the Equivalent Residential Units (ERU's) that are served by a particular node. Residences were mapped to the node most likely to serve them by considering the location of their water meter. When there were long pipes between nodes, the demands were weighted more heavily on the downstream node to provide the most conservative assumption. A detailed list of nodes and apportioned unit demands appears in **Appendix 3-F**.

Unit demands were created for each modeling alternative with calculated flow multipliers determined to reflect the demands of the particular scenario. Demand on the network is found to have a daily or "diurnal" fluctuation that varies as shown here:

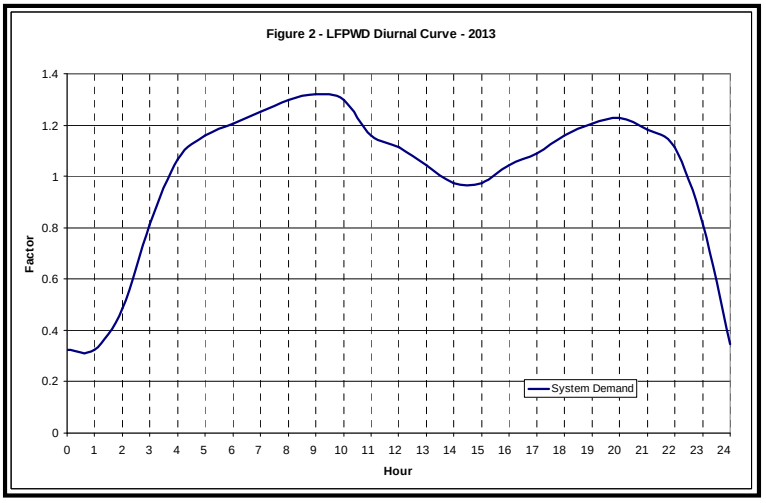
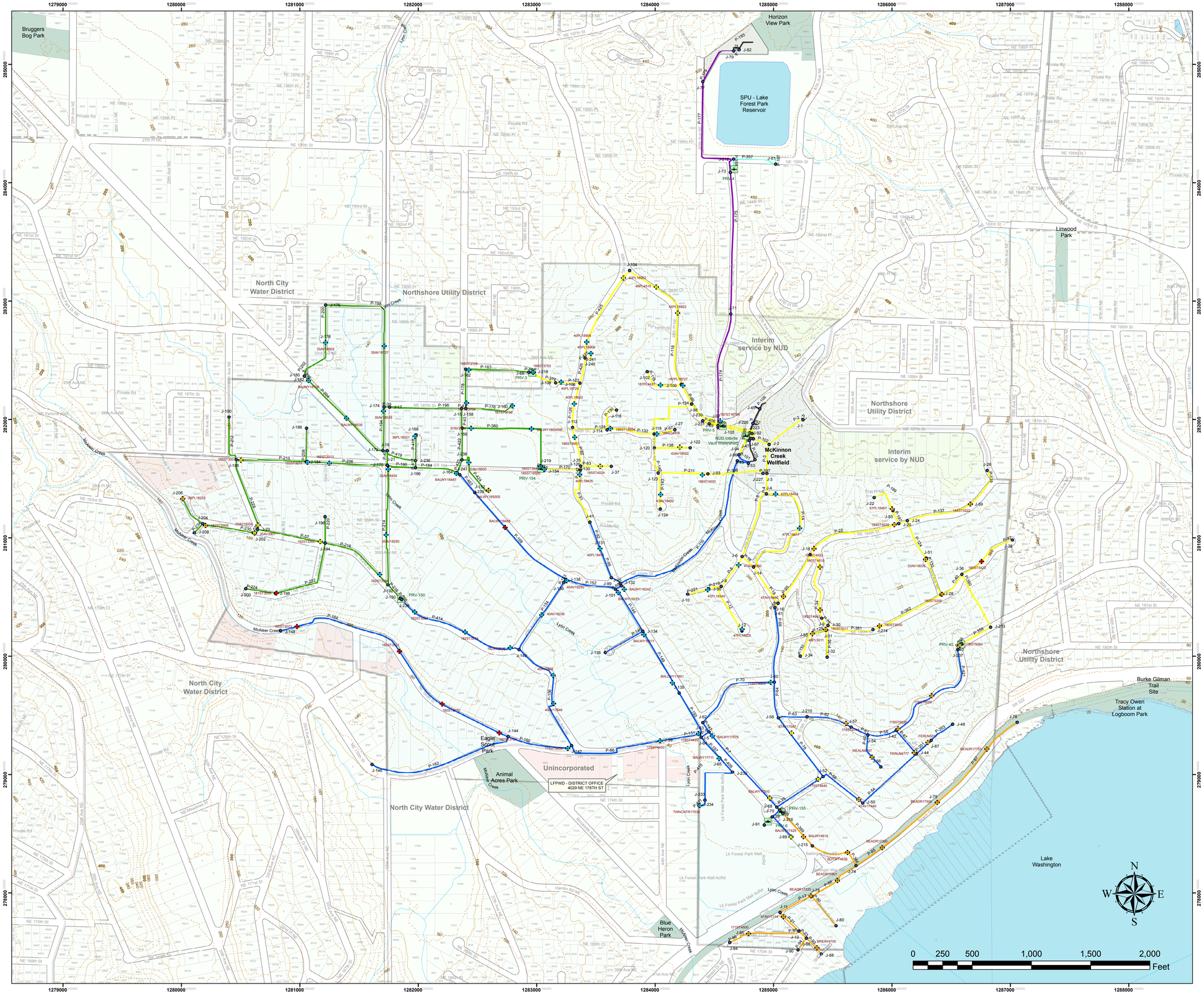


Figure 3-8 Existing Water Network Model



LAKE FOREST PARK WATER DISTRICT

FIGURE 3-8
WATER MODEL NETWORK
PIPES, JUNCTIONS, FIRE HYDRANTS AND PRESSURE REDUCING VALVES

Legend

Active Junction
- Model Junction
- PRV

Fire Hydrants 2014
- 700-1000GPM
- 1000-2000GPM
- 2000-2500GPM
- 2500GPM+

Network Pressure Zone
- Beach Zone
- High Zone
- Horizon_View
- Intermediate Zone
- Low Zone
- SPU Tolt
- Towne Centre
- Well Zone

Contours
- 20
- 100

NAME
- North City Water District
- Lake Forest Park Water District
- Right of Way
- Lake Forest Park Property Parcel
- Street
- Water Course
- Water Body
- Wellfields
- Park

Parcels Served by Others
- NCWD
- NUD

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

MUNDALL ENGINEERING & CONSULTING
P.O. Box 799
Sumas, Washington 98295
P.O. Box 56 Toll Free
Lytton, B.C. V0K 1Z0 1-800-313-9705
Bus. (250)-455-0086 Cellular (360)-319-1285
FAX (250)-455-2276 E-Mail Dan@Mundall.com

Water System: February 2015
Parcels, Streets, Right of Way, Elevation Contours, Water Features, and Political Boundaries from King County GIS, May 2015

This map is based on best available data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

NAD_1983_HARN_StatePlane_ Washington_North_FIPS_4601_Feet

MAP DATE: August 2016

WATER NETWORK MODEL CALIBRATION

To further aid in its predictive ability, the model was calibrated by comparing measured residual system pressure under six demand scenarios to predicted residual pressure in the network model. This calibration step resulted in an adjusted roughness coefficient for various pipe sizes and materials that closely predicts observed behavior. Demand was created by open fire hydrants with pitot type flow measurement devices attached. Refer to **Appendix 3-G** for the 2013 Calibration Plan and the detailed results obtained from these tests.

Each calibration test commenced with various isolation valves closed (see Calibration Plan) in order to restrict flow to specific water mains and thus avoid redundant flow paths and additional uncertainty.

- Flow measurement for test "A" was manually observed from an 8" mag meter connected to the pumper port. Other tests were observed and totaled from two 2 - 1/2" diffusers equipped with pitot style gauges. Average flow rates were recorded at the various valve states, ending with the isolation valves in their normal position.
- Residual pressures were recorded automatically by a total of four Monarch Instruments 'Track-it' pressure loggers which were time correlated and configured to log pressures at an interval of one second. Secondary pressure readings were also recorded manually by reading a pressure gauge attached to the data logger. Logged pressure readings were calibrated to the Hydraulic Grade Line (HGL) measured prior to the flow test.
- HGL for zones fed by tanks were tracked automatically by the District's SCADA system and various granular adjustments were made in the calibration calculations to compensate for changes in tank levels during the test.

CALIBRATION PROCEDURES

Bentley WaterCAD V8 includes an iterative calibration feature called "Darwin Calibrator" that can modify a number of variables within a specified range to generate a "best fit" model. The pipe roughness factor was the only variable selected for modification during these fitness trials. There are various criteria for evaluating an acceptable model correlation and the one chosen for this analysis was described by Walski et al. 2003. The method involves obtaining pressures at relevant points during high flows in the network and then building a model that is successful at predicting Hydraulic Grade Lines (HGL) of corresponding model flows to a maximum difference of 5 - 10ft-H2O (2 - 4psi).

The calibration process did initially reveal substantial miscorrelation between the model and the physical network in two flow scenarios that required corrections. In one case an isolation valve in the McKinnon Creek wellfield was discovered to have been left only partially open and resulted in about 50psi drop. The valve was subsequently opened to its normal fully open position and the flow test was re-run with satisfactory results. In another case reverse-flow between two pressure zones needed to be accounted for in the model by installing a check valve analogous to the physical network.

The **Figure 3-9** (following page) shows the degree of correlation between observed and model simulated HGL at 4 pressure monitoring points for each of 8 calibration tests in the network. There is a very high degree of correlation of predicted vs. observed as seen here:

Statistical Parameter	Value
Average diff. ft	0.99
Rsquared Coef.	0.996
Maximum	8.63
Std. Deviation	4.75

Table 3-12 (following page) summarizes the resulting friction coefficients that were generated by Bentley WaterCAD Darwin Calibrator as a best fit to observed pressures. The network model was subsequently modified with these friction coefficients for all simulations. Note that there is no differentiation of friction coefficient by pipe age; observed and model predicted correlate very closely and there is no justification for age related change in friction factor.

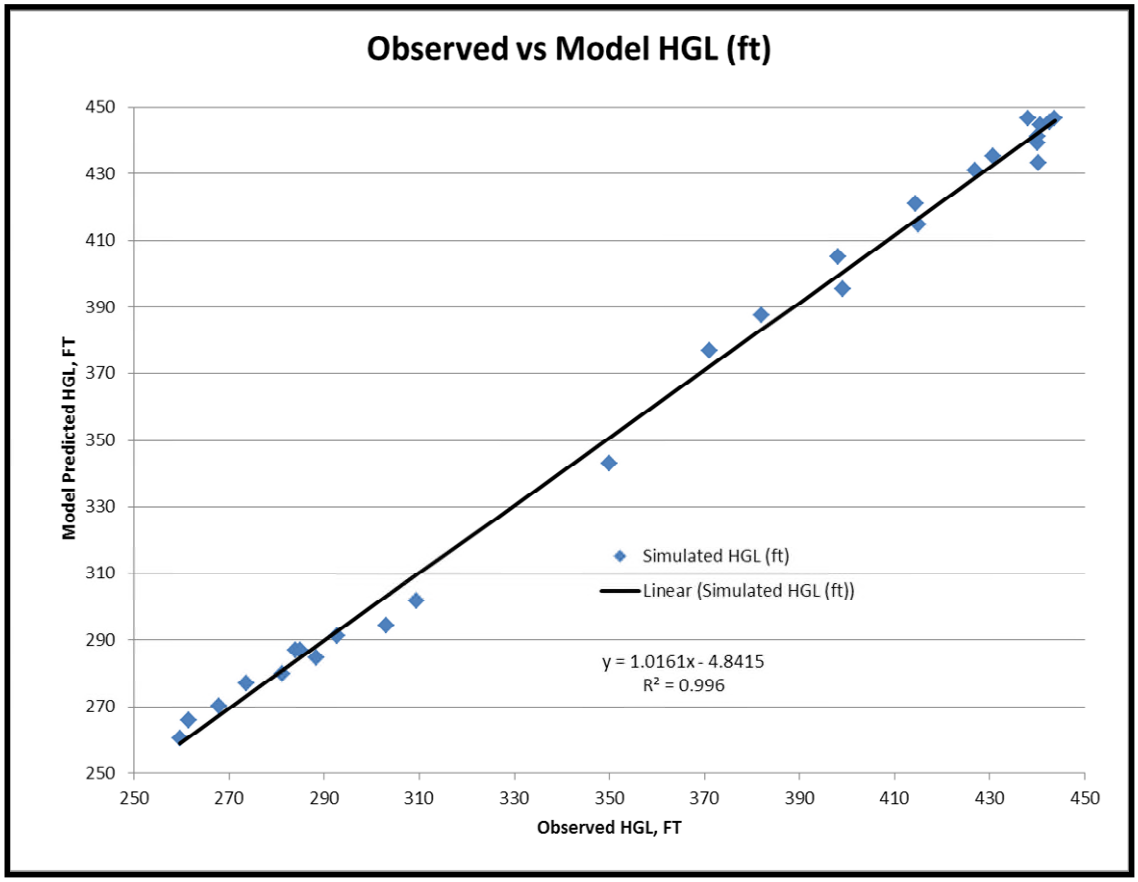


Figure 3-9 Water Model Correlation

Pipe Size and Type	Hazen-Williams "C" Friction Coef.
8" Steel	70
6" Steel	85
6" Asbestos Cement	115
8" Asbestos Cement	115
12" Ductile Iron	115
8" PVC	125
8" Ductile Iron	130
10" Ductile Iron	140
8" HDPE	**170**
10 HDPE	170

Table 3-12 Corrected System Pipe Friction Coefficients Determined by WaterCAD "Darwin Calibrator"

III. HYDRAULIC MODEL RESULTS AND PROPOSED SYSTEM IMPROVEMENTS

INTRODUCTION

The previous sections of Part III have prescribed standards for system performance and identified infrastructure deficiencies and proposed improvements as determined from observation, inspection, records of life span, operating history, performance data, and detailed hydraulic analysis. This section summarizes findings of hydraulic modeling of the system and recommends improvements based on these findings.

Part VIII of this report outlines a comprehensive improvement program to address infrastructure, operational and administrative deficiencies with projected financial outlay and schedule.

DISTRIBUTION SERVICE PRESSURE AT STATIC AND PEAK HOUR FLOW CONDITIONS

Service pressures were evaluated with elevations *at the location of each water meter*. **Table 3-13** and **Figure 3-10** describe the current distribution of static service pressures at the customer water meter. A map of service pressures in the system appears in **Appendix 3-K** for reference.

PRESSURE	Beach (HGL 332ft)	Low (HGL 294)	Intermediate (HGL 342ft)	High (HGL 452ft)	Horizon (HGL 569ft)	ALL PRESSURE ZONES
Minimum Service Pressure	77	47	62	45	no services	**45**
Maximum Service Pressure	91	105	98	129	no services	**129**
Average Service Pressure	88	83	80	83	no services	**83**
# Services Below 30psi	0	0	0	0	0	**0**
# Services between 30 - 80psi	2	101	107	144	0	**354**
# Services between 80 - 120ps	78	160	141	148	0	**527**
# Services Above 120psi	0	0	0	13	0	**13**
TOTAL	**80**	**261**	**248**	**305**	**0**	**894**
Edit: 2/12/2015						
File: LFPWD_Meters_11_2014						

Table 3-13 Static Distribution Service Pressures at Customer Meters

raid2:\\System Plan Work\ LFPWD_Meters_11_2014.xls

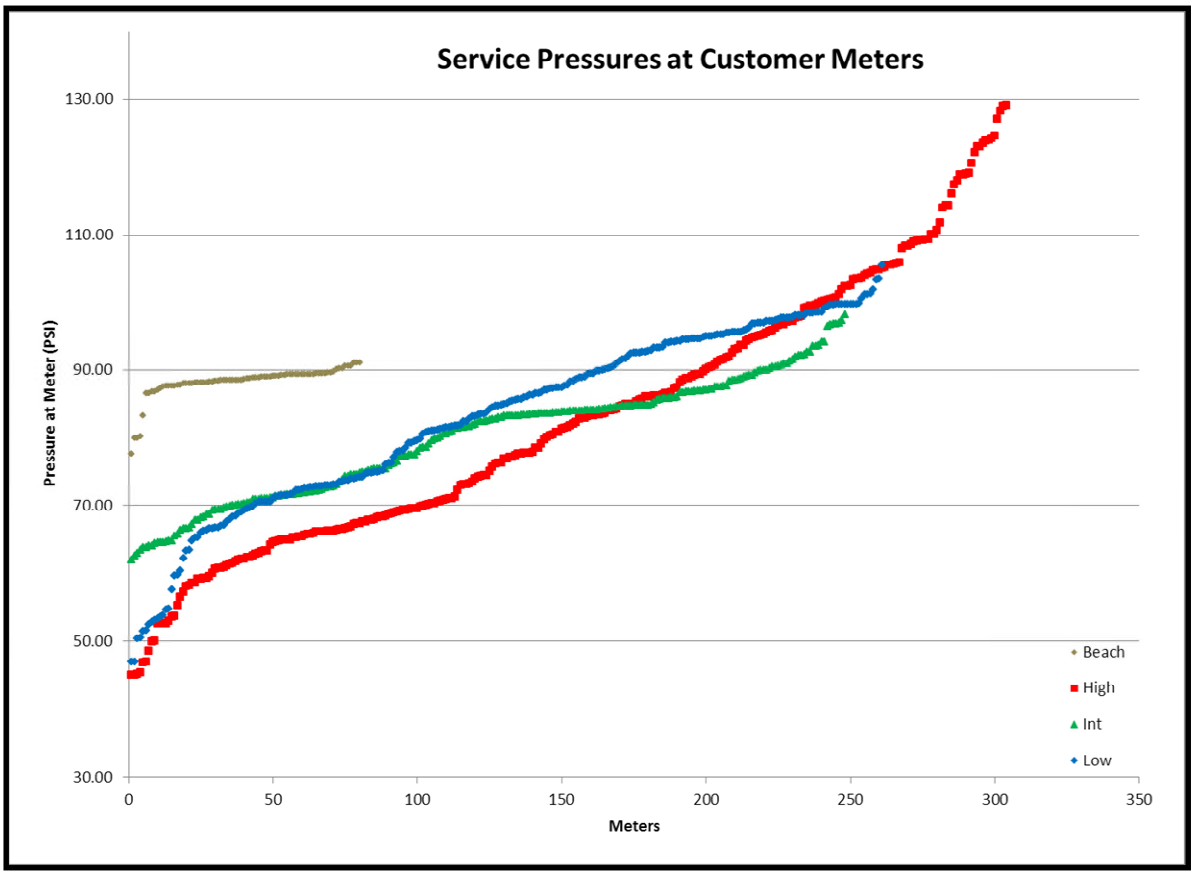


Figure 3-10 Static Service Pressures at Customer Meters

raid2:\\System Plan Work\
LFPWD_Meters_11_2014.xls

Hydraulic analysis of the existing system shows that it has sufficient hydraulic capacity to deliver peak hour demands at the required minimum service pressure of 30 psi to all existing customers. In fact, service pressures in the District are high compared to what are recommended by WSDOH and AWWA. The *Minimum* static service pressure in the system is 45 psi, Average static service pressure is 83 psi and more than half of the District customers have a static service pressure greater than the recommended maximum of 80 psi. About 13 customers have service pressure greater than the District "maximum desirable" service pressure of 120 psi.

However there are valid reasons that justify higher pressures in this network and these include:

- Steep topography of the District's service area would require additional pressure zones, piping and pressure reducing valve stations, creating additional cost and complexity of system management with less looping in the system.
- Many homes are situated on steep slopes above the street and water service pressure that is technically "high" at the customer meter might in fact be inadequate at the residence. Lowering line pressure could result in insufficient pressure for these customers.

- Many homes in the District have undersized, old tuberculated galvanized iron pipe services and there is considerable pressure loss. Downward adjustment of system pressures would create substandard capacity at the customer tap.
- Re-assigning pressure zones could impair performance of the network for fire conditions.

In consideration of the above, and in accordance with WSDOH guidelines the District will advise customers (where service pressure may exceed 80 psi) in writing of the possible need for a pressure reducing valve at the meter.

Note that there are areas of boundary overlap along the northern border of LFPWD where customers within LFPWD corporate boundary are currently served by NUD. These areas could be adequately served with the new Horizon View pressure zone (HGL 569) using the newly constructed transmission main on 46th Ave.

INSTANTANEOUS FIRE FLOW CAPACITY EVALUATION

A Maximum (Peak) Day flow condition + fire flow creates a greater strain on the LFPWD network than peak hour conditions. However, improvements to transmission and distribution piping over the past 15 years have greatly increased the ability of the network to deliver adequate fire flow in accordance with WSDOH standards (see Table 3-11) and fire flow no longer ranks as the highest priority overall in system improvements.

Two fire flow scenarios were modeled with WaterCAD to evaluate adequacy of the network hydraulics:

Residential Fire 1000gpm + Max (Peak) Day Capacity

Observations: A simulation of the network in '2000 showed that almost half of the District hydrants could not provide a minimum 1000gpm with 20 psi residual as required by WSDOH. In the intervening years the District made significant effort to strengthen the network through construction of new transmission and distribution piping as well as replacement of failing undersized piping. In the current model (2014) all but 5 (five) hydrants exceed 1000 gpm. Detailed listings of simulated capacities appear in **Appendix 3-H** for current (2014), 2020, 2025 and 2033 planning scenarios. All hydrants are projected to exceed minimum required capacity for residential fire by 2020. Note that there are still a handful of hydrants with smaller barrel sizes which could impact their ability to deliver the calculated flow although these will be replaced during scheduled watermain upgrades.

Commercial Fire + Max (Peak) Day Capacity

Observations: Standards for fire suppression capacity in non-residential structures are established by ISO and local fire departments. Northshore Fire District covers the entire service area of LFPWD. There are a handful of commercial and institutional class structures in the District for which capacity in excess of 1000gpm is required and these are evaluated on a case by case basis. **Table 3-14** below summarizes instantaneous fire protection flow required and available to non-residential facilities as modeled by WaterCAD.

Entity – Structure address	Needed Fire Flow (ISO/Fire Dept.) gpm	2013 Field Test gpm	2014 Model Predicted Capacity gpm	2020 Model Predicted Capacity gpm	2033 Model Predicted Capacity gpm
***LFP Towne Center – 17171 Bothell Way (to North end of premises)**	3,500	> 3,500	> 3,500	> 3,500	> 3,500
Bank of America – 17181 Bothell Way	1,750	Towne Center Hydrants	Towne Center Hydrants	Towne Center Hydrants	> 3,500
LFP City Hall - 17425 Ballinger Way	2,000	N/A	2,063	> 3,500	> 3,500
LFP Elementary School - 18500 37th Ave.	3,000	N/A	>3,500	>3,500	>3,500
Windermere Reality - 17711 Ballinger Way	2,500	>3,500	>3,500	>3,500	>3,500
Whizz Kids Academy 18512 Ballinger Way	1,750	>3,500	>3,500	>3,500	>3,500
LFP Market - 18498 Ballinger Way	1,500	N/A	>3,500	>3,500	>3,500
Ballinger Automotive	1,500	N/A	> 3,500	>3,500	>3,500
Asia Today Printing / Denture Clinic – 17250 Bothell Way	1,500	N/A	> 1,146	>2,030	**??**

Note: Multiple hydrant spacing and capacity requirements for large facilities not considered here.

Table 3-14 Fire Suppression Capacity at Commercial/Institutional Facilities

***Note**: Seattle Public Utilities notified the District of their intent to abandon (upon service agreement ending December 2011) a 16" watermain on Bothell Way that had provided fire protection capacity to the facility since 1963. In 2010 the District upgraded its 12" feeder main on Ballinger Way between 184th Street and 178th Street to ensure continuous 12" transmission main from the 250,000 gal "Low Zone" (HGL 292 ft) Reservoir to the Towne Center. In 2014 the District and LFP Town Center constructed a new 10" watermain into the north end of the facility to augment fire protection capacity in immediate proximity to the structures and replace capacity of the SPU Bothell Way pipeline which was abandoned at the end of 2014. Flow tests are required to confirm adequacy of the new service to deliver adequate fire flow to the facility.

Instantaneous capacity to non-residential structures appears adequate with exception of:

- Asia Today Printing (on Bothell Way) where existing capacity is around 1,000 gpm. Replacement of existing 6" steel on Ballinger near Bothell Way will increase this to over 2,000 gpm. Further improvement of instantaneous capacity is expected with completion of the 12" extension from LFP City Hall across Bothell Way by 2033. The District is presently working on a combined project to install a casing under Bothell Way to carry the proposed watermain which will eventually improve capacity and provide redundancy to the Beach zone.
- Modeled fire flow to the LFP City Hall barely meets ISO/Fire Marshall requirements at 2,063 gpm. The proposed upgrade of the12" transmission main on west shoulder of Ballinger between 178th and 175th will increase available flow to over 3,500 gpm. A portion of this is complete at present with the Windermere extension and the LFP Towne Center north service project but about 500 lin-ft remain.

FIRE FLOW DURATION AND ADEQUACY OF SUPPLY

Needed Fire Flow (Capacity), gpm	Required Duration, hours
1,000 – 2,500	2
3,000 – 3,500	3

ISO guidelines and the local fire department require fire flow model calculations to be sustained commensurate with the potential size of fire to ensure that water systems are not prematurely depleted. Greater flow requires longer duration. The table (right) shows ISO requirements for various fire flow demands. Fire flow and duration are especially crucial for small water systems because fire needs are so large compared with peak customer demand.

The "extended period simulation" tools of network analysis programs such as WaterCAD create a series of time slices of network conditions such as reservoir levels, pump capacities etc. and propagate these over the course of the simulation. In this case, we are particularly interested what happens during the required duration of a fire to see if the system can provide sufficient duration and flow to meet requirements.

The following conditions are of particular interest in the analysis as they account for realistic possibilities:

Scenario	2014 – 2015 (Present day)	2020 Condition (6 year)	2033 Condition (20 year)
Low/Beach zones	Residential 1000 gpm, 2 hrs Commerical 1,500 gpm, 3hrs (Asia Today Printing)	Residential 1000 gpm, 2 hrs Commerical 1,500 gpm, 3hrs (Asia Today Printing)	Residential 1000 gpm, 2 hrs Commerical 3,500 gpm, 3hrs (New Development)
High/Intermediate zones	Residential 1000 gpm, 2 hrs Commerical 3,000 gpm, 3hrs (LFP Elementary School)	Residential 1000 gpm, 2 hrs Commerical 3,000 gpm, 3hrs (LFP Elementary School)	Residential 1000 gpm, 2 hrs Commerical 3,000 gpm, 3hrs (LFP Elementary school)
Horizon view zone	Residential 1000 gpm, 2 hrs	Residential 1000 gpm, 2 hrs	Residential 1000 gpm, 2 hrs

Table 3-15 Fire Demand and Duration Conditions

Figures 3-11 through **Figure 3-17** below contain the results of extended period simulation of fire flow conditions both for the present and for anticipated future conditions where infrastructure improvements are planned along with some increase in system demand due to growth.
Figure 3-11 below is created by an extended period simulation of reservoir levels during a 2-hour 1000 gpm residential fire in the Low zone (HGL 292) under current (2014) conditions. Note that in the present system water from Horizon View/Seattle Intertie is conveyed into the High zone (HGL 452) without direct connection to the Low Zone (HGL 292) except through two distribution PRV stations that were not triggered in this scenario.

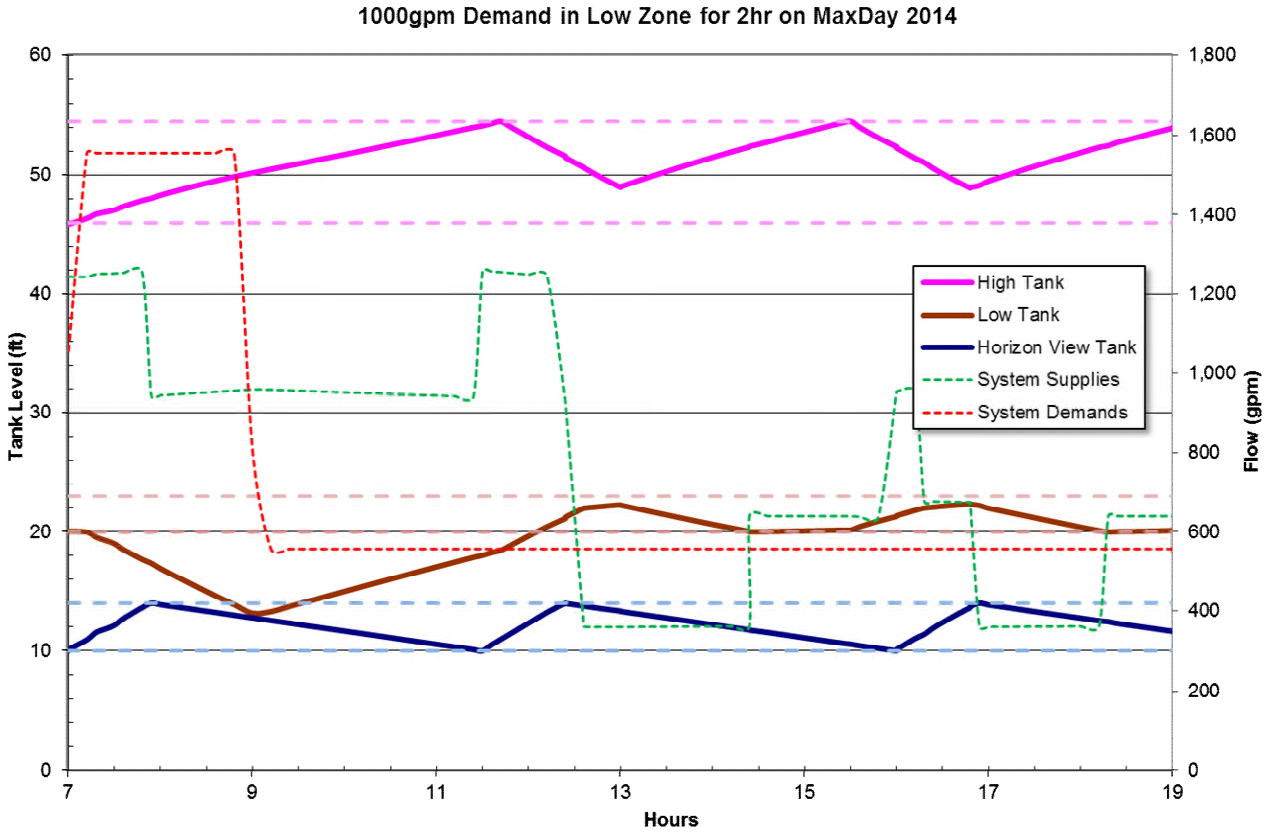


Figure 3-11 Reservoir Levels during Residential (1000 gpm) Fire in Low Zone 2014

raid2:\\System Plan Work\System Hydraulics\

Observations: The Low zone reservoir is depleted to 14 feet depth but adequate reserve remains.

Figure 3-12 below is created by an extended period simulation of reservoir levels during a 2-hour 1,000 gpm residential fire in the High/Intermediate zones in 2014-2015.

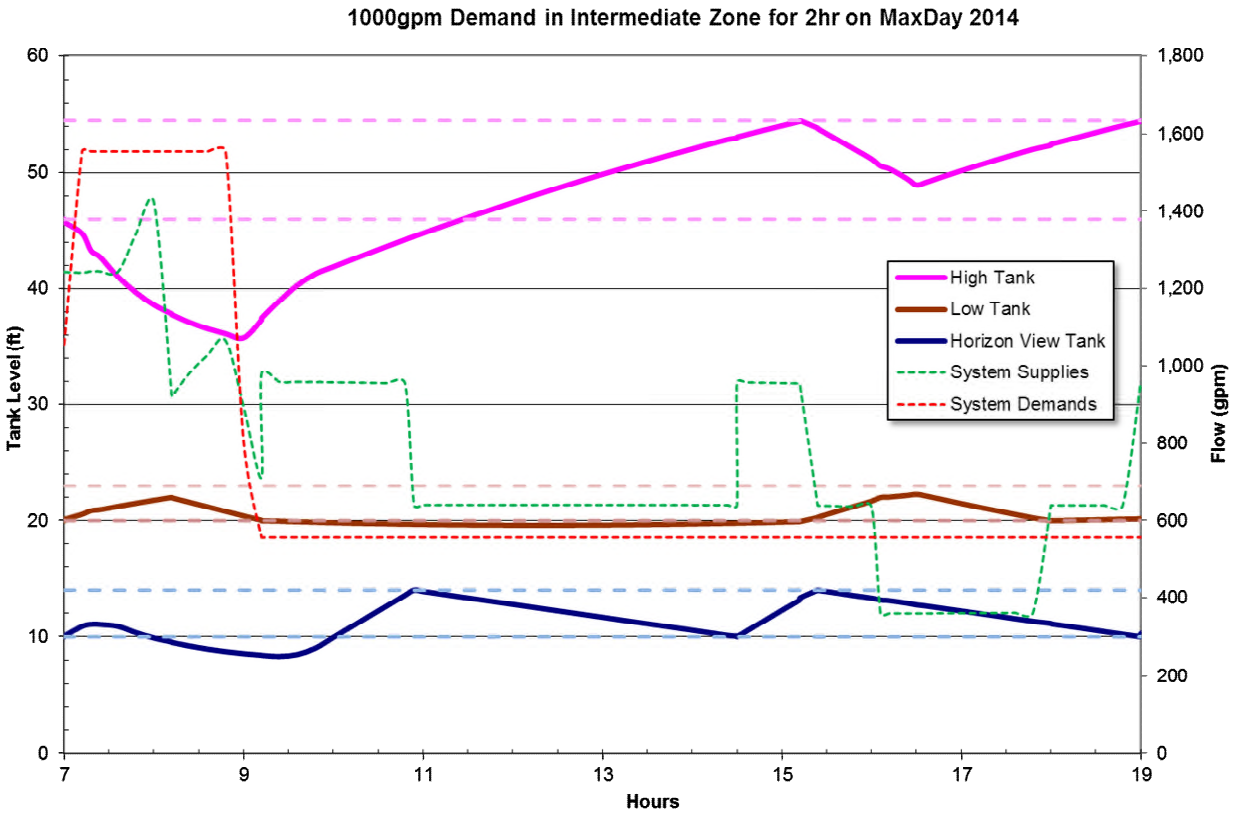


Figure 3-12 Reservoir Levels during 1,000 gpm Fire in High/Intermediate Zones 2014

Observations: This scenario is adequately supported by reserve in the High zone standpipe tank as well as the SPU intertie. Depletion of the High zone standpipe tank to about 37 feet would not impair service pressure to customers.

Figure 3-13 below is created by an extended period simulation of reservoir levels during a 3-hour 3,500 gpm fire in the Low zone such as would be expected during a fire at the Lake Forest Park Town Center in 2014-2015.

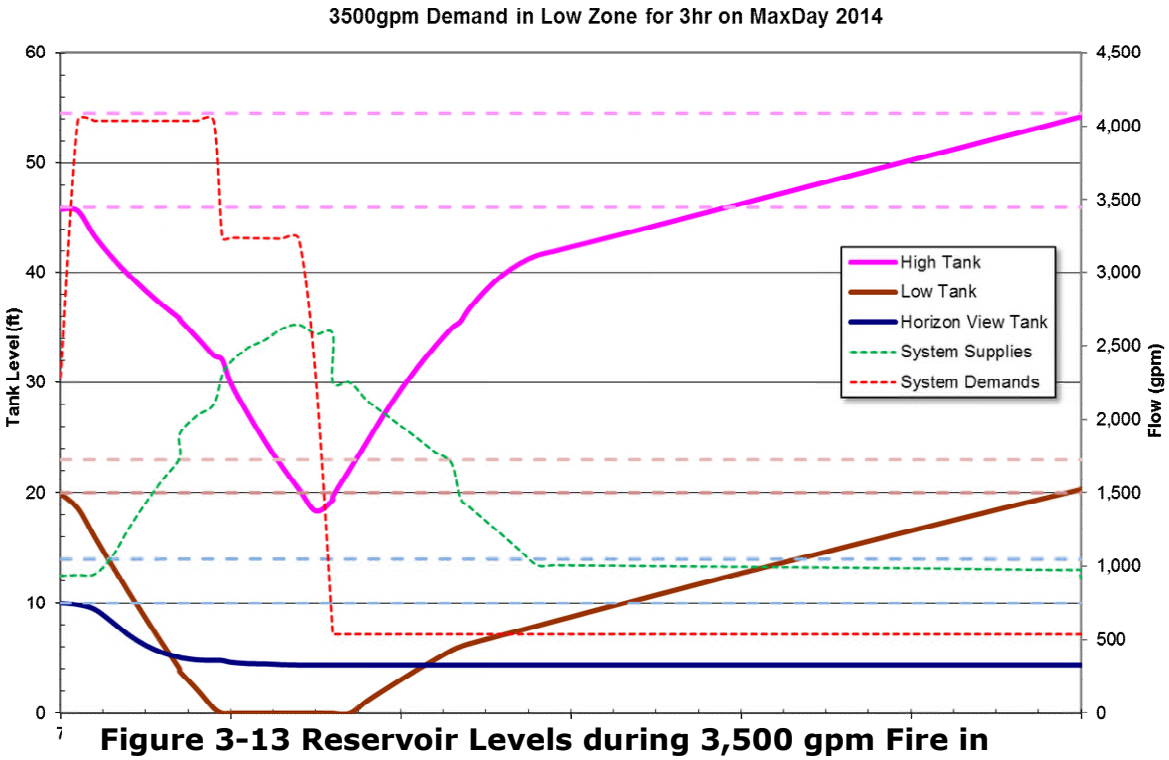


Figure 3-13 Reservoir Levels during 3,500 gpm Fire in Low Zone 2014

Observations: This scenario results in complete depletion of the Low zone reservoir after about 2 hours then with the Low zone reservoir empty a maximum of about 2,700 gpm would be available for a fire. The High zone standpipe tank is also depleted below levels needed to sustain 20 psi pressure at all customers in the network and there is a net deficiency of about 60,000 gallons.

Note: The benefit of an existing intertie with Northshore Utility District at McKinnon Creek is not considered in these calculations as this intertie is not recognized in storage reserves by NUD as presently required by WSDOH. The NUD intertie has a tested capacity of 500 gpm. The benefit of this intertie over a 3 hour fire would be close to 90,000 gallons.

Several actions are underway to remedy the current supply/storage deficiency shown in **Figure 3-13** including:

1. **Install 10" PRV in the new McKinnon Creek pumping facility** to admit flow from Horizon View zone (HGL 569) directly to Low zone (HGL 292).
   ***Effect**: increase capacity of SPU intertie from 1250 gpm to 2000 gpm by lowering HGL of discharge into the LFPWD network at McKinnon Creek wellfield.*

2. **Bring new pumping facility on-line at McKinnon Creek**
   ***Effect**: increase source capacity at McKinnon Creek so total water production (McKinnon Creek + Horizon/SPU Intertie) is increased.*

Historical note: the existing 10" and 8" intertie/transmission piping from 195th Street was constructed as part of a 2003 mitigation settlement with King County that only obligated the County to a design capacity of only 750 gpm. During design of the 195th Street intertie the County agreed to increase design capacity to 2000 gpm. This resulted in upsizing of portions of the intertie to 10" (195th Street and 187th Street HDD HDPE pipe into McKinnon Creek WHPA.) although the main transmission pipe on 46th Ave. was left 8" partly to avoid the risk of permitting complications under SEPA for piping greater than 8". As a result the intertie capacity is 2000 gpm, which is less than the 3500 gpm allowed in the agreement.

Figure 3-14 below demonstrates the same conditions as **Figure 3-13** (3-hour 3,500 gpm fire in the Low zone) but with the benefit of the remedial actions listed above. These remedial actions are assumed to be completed in a 2020 scenario.

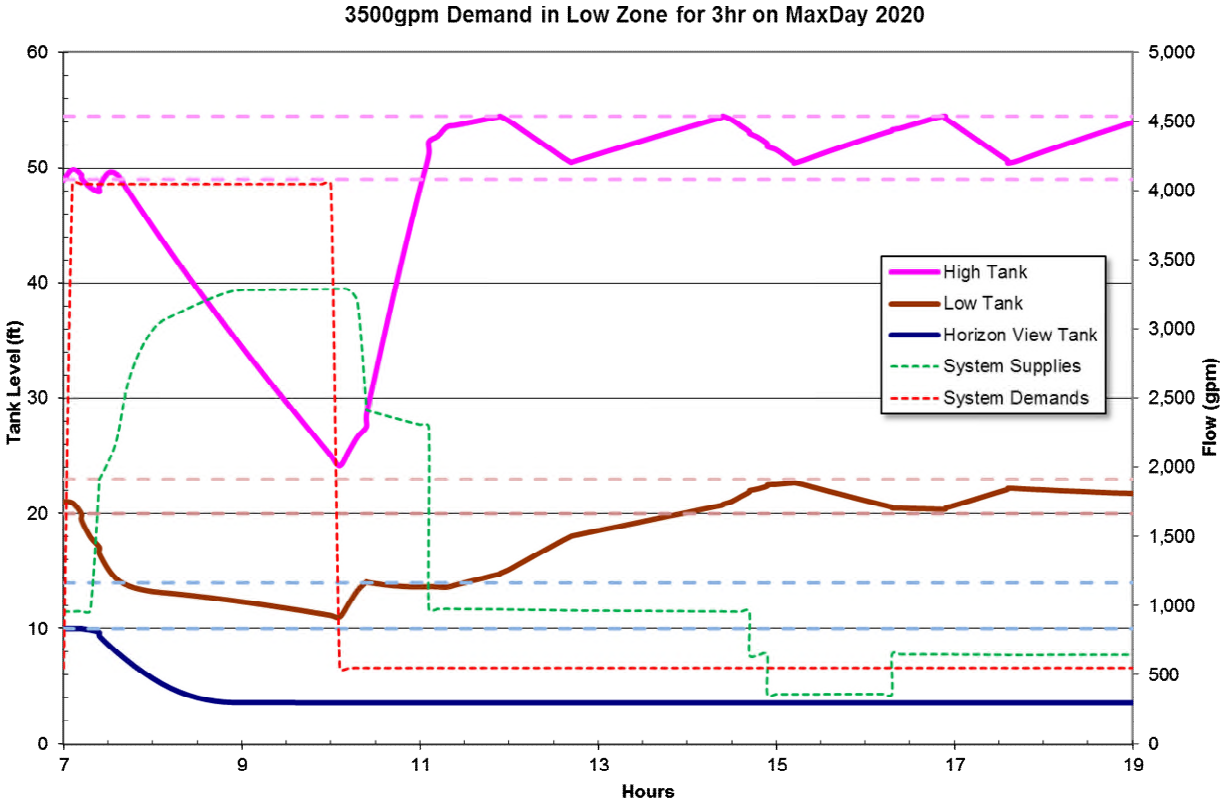


Figure 3-14 Reservoir Levels during 3,500 gpm Fire in Low Zone 2020

Observations: This scenario reflects construction of the new McKinnon pumping facility which will include valves for controlled admit from Horizon View Zone to High and Low zones. The scenario draws down the High zone standpipe tank level to about 24 feet and Low zone reservoir to 11 feet although this would not reduce service pressures below the 20 psi minimum.

Figure 3-15 below is created by an extended period simulation of reservoir levels during a 3-hour 3,000 gpm fire in the Intermediate zone at the LFP Elementary school (Ballinger & 37th Ave.) in 2014-2015.

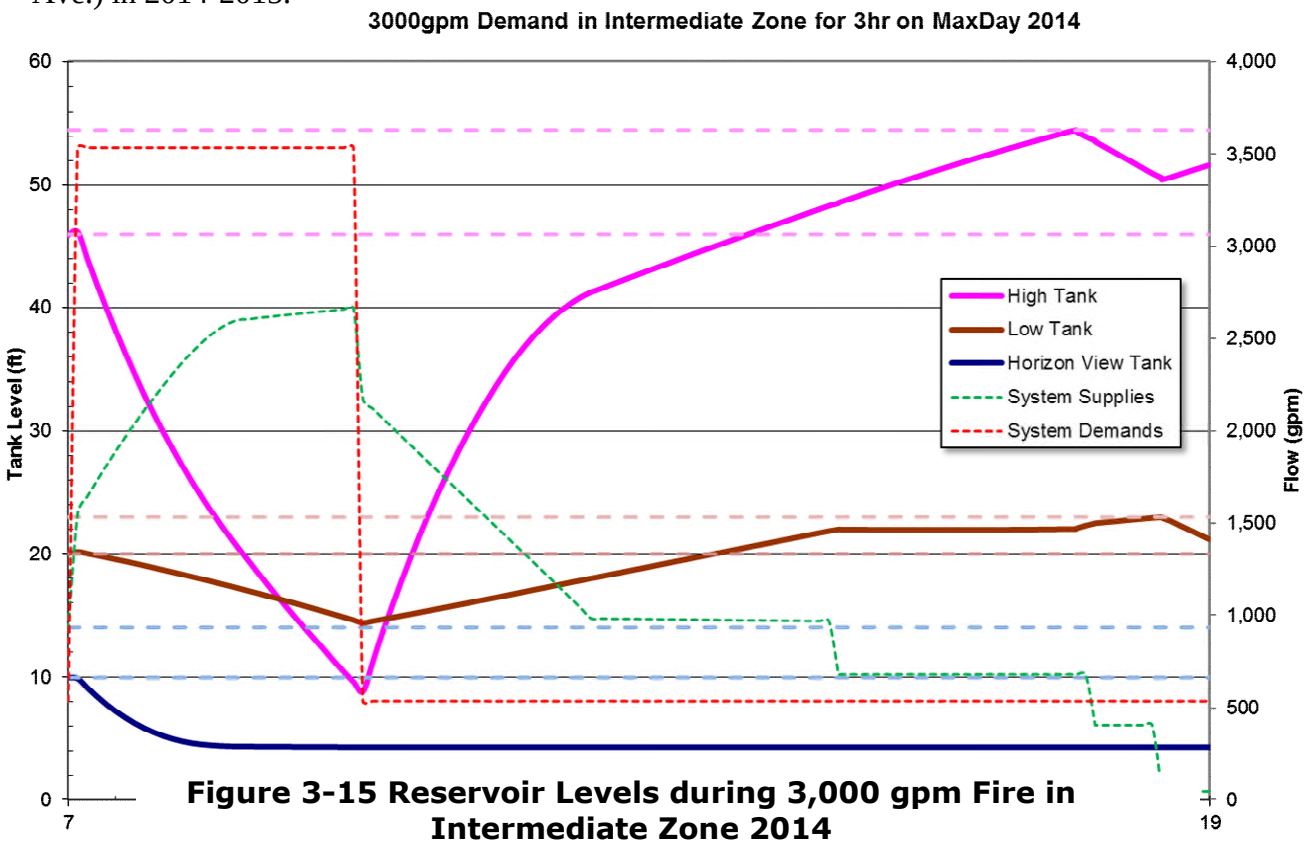


Figure 3-15 Reservoir Levels during 3,000 gpm Fire in Intermediate Zone 2014

Observations: This scenario would excessively deplete the High zone standpipe tank within the first two hours and some customers on 51st Place would have less than 20 psi when the standpipe dropped below 33ft. After 3 hours the standpipe level would be about 8ft; which while not empty, is technically insufficient to supply the minimum 20 psi residual pressure to all customers as required by WSDOH.

Network design changes are underway to remedy the supply/storage deficiency shown in Figure 3-15 including:

1. Install 10" PRV in the new McKinnon Creek pumping facility to admit flow from Horizon View zone (HGL 569) directly to Low zone (HGL 292) – this has the effect of increasing total flow from SPU intertie.
2. Install 12" pipe on Ballinger between 37th Ave. and 40th Ave. that will have a PRV with reverse check capability to admit flow into Intermediate zone during a fire. This would augment available fireflow at 37th & Ballinger with up to 600 GPM from the Low zone.

Figure 3-16 below is created by an extended period simulation of reservoir levels during a 3-hour 3,000 gpm fire in the Intermediate zone at the LFP Elementary school (Ballinger & 37th Ave.) in 2020.

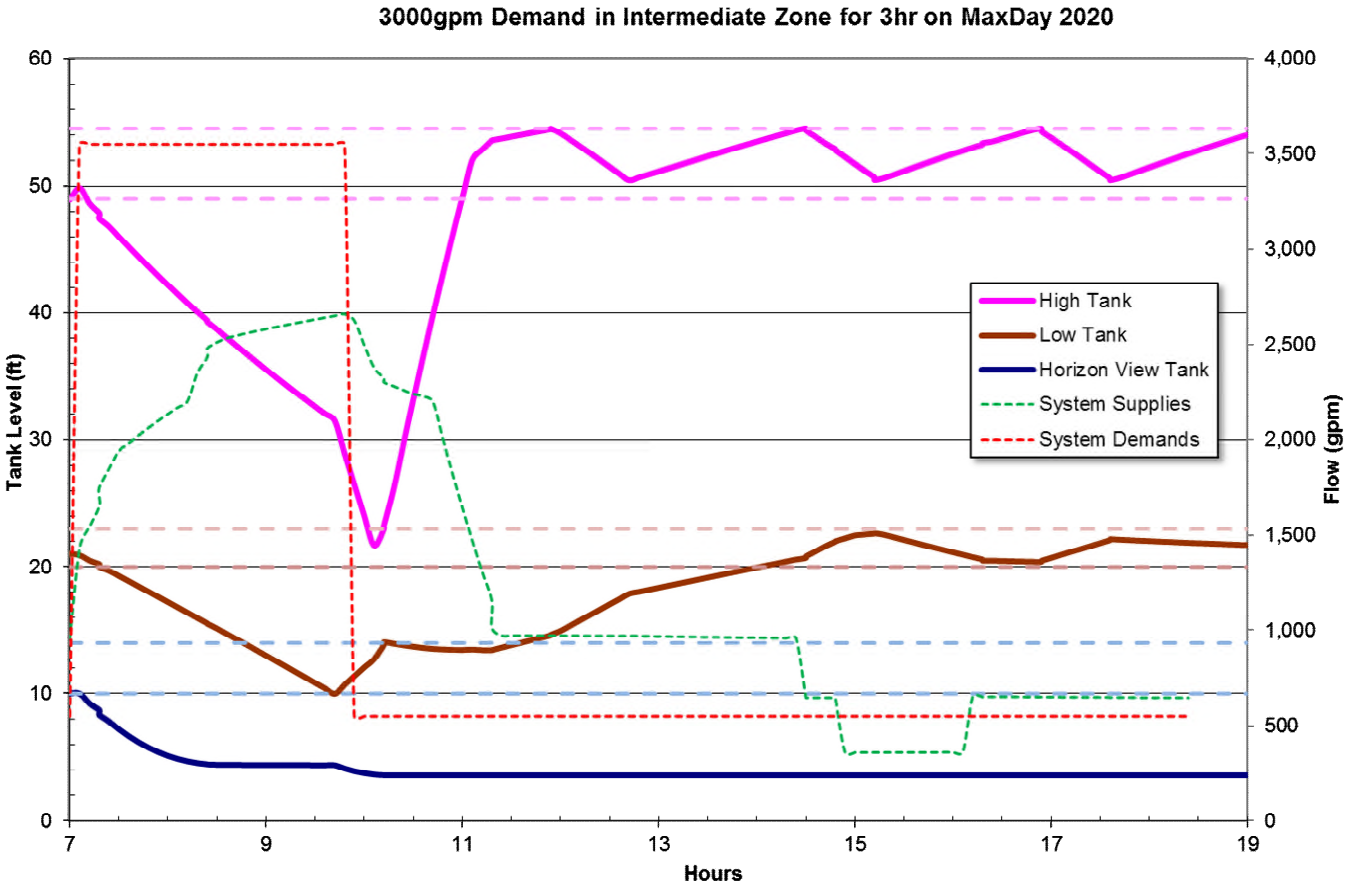


Figure 3-16 Reservoir Levels during 3,000 gpm Fire in Intermediate Zone 2020

Observations: This scenario admits water from Horizon zone to Low Zone when the Low zone reservoir is < 10 feet. The scenario still depletes the High zone standpipe tank although it would see pressures only slightly less than 20 psi for a handful of customers on 51st Place. Additional improvement in the District's capacity to provide for large commercial fires in the High/Intermediate zones (or Horizon zone) is not likely unless the District either:

a. constructs additional storage, or
b. constructs a new intertie with SPU-Tolt at 193rd Street (approximately 1,600 feet north of the terminus of existing 10" HDD HDPE pipe which delivers water from the 195th Street SPU-Tolt intertie. SPU requests that the District contact the Wholesale Contracts Manager (currently Terri Gregg) to arrange mutually agreeable terms if the District wishes to pursue construction of a new intertie at 193rd Street.

These options are considered as part of Developer Extension terms with any large proposed commercial development that may require more fire flow than is available now.

Figure 3-17 below is created by an extended period simulation of reservoir levels during a 3-hour 3,000 gpm fire in the Intermediate zone at the LFP Elementary school (Ballinger & 37th Ave.) in 2033.

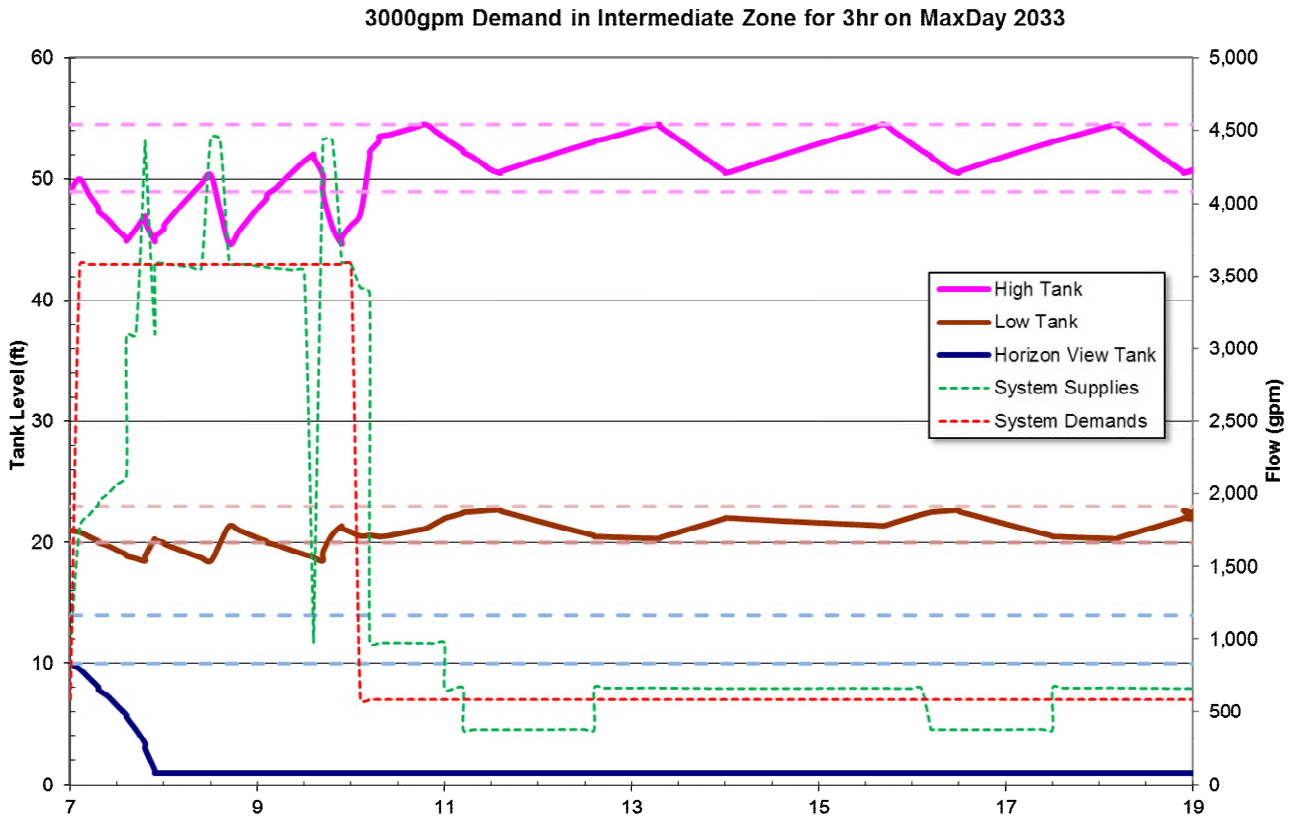


Figure 3-17 Reservoir Levels during 3,000 gpm Fire in Intermediate Zone 2033

Observations: There is a new intertie with SPU-Tolt at 193rd Street (approximately 1,600 feet north of the McKinnon Creek connection pipe). The result is stable reservoir levels even during a 3-hour fire demand of 3,000 gpm in the Intermediate pressure zone.

OTHER HYDRAULIC CONSIDERATIONS

In future scenarios (post 2014) the system was modeled with the assumption that the downstream pressure of 187th Street PRV is adjusted upward to HGL 569 in order to provide full Horizon View zone pressure into the McKinnon Creek wellfield.

Two new PRV's are proposed in the McKinnon Creek pump facility to admit water from Horizon View zone (SPU Intertie) as follows:

- 8" PRV into High zone (HGL 452) opens when Standpipe level is less than 48 feet, and;
- 10" PRV into Low Zone (HGL 292) opens when Low zone reservoir levels are less than 10 feet.

Adequacy of supply for commercial fire fighting in the High/Intermediate or Horizon View zones will remain limited until a new more robust connection with Seattle-Tolt pipeline is constructed, or unless additional storage is constructed in the vicinity of commercial fire demands. While either option is conceivable a new connection with the Seattle-Tolt is proposed at the Tolt pipeline crossing on 193rd Street as the most viable option. This intertie would be covered as an additional withdrawal point under the existing emergency intertie agreement with Seattle and would require about 1,600 feet of transmission main to the McKinnon Creek wellfield. Note that the proposed 193rd Street intertie would also add critical redundancy if the District assumed service to areas in the corporate service boundary that are currently served by NUD.

The addition of the newly constructed Horizon View wellfield and SPU-Tolt Intertie (195th Street) makes the LFPWD supply system much more robust and reliable. For instance, a power outage at McKinnon Creek is unlikely to affect pumps at Horizon View and vise-versa. The new source/supply system has potential to partially replace the McKinnon Creek source for some conditions. **Table 3-16** below compares cost of pumping energy for both source systems. These data suggest that pumping cost to the High/Intermediate zone is similar for each source, although water supplied to the Low/Beach zones would cost more to pump if supplied through the Horizon View system.

Comparison of pumping energy costs for LFPWD

Location	Amps	Volts	Flow (gpm	Notes	PF	Power kw	kw-h/ Mgal	$/Mgal @ $0.075/kw	TOTAL
Horizon View DW #1 (BAM416)	56.2	480	340	Amps/flow meas. at startup in 2013	1	46.72	2290.38	$172	
Horizon View DW #2 (BAM417)	56.2	480	340	Amps/flow meas. at startup in 2013	1	46.72	2290.38	$172	$172
McKinnon Cr. DW#1	26	480	325	Amps meas. by Nelson Elec. Nov. 2003, flow by anal. Pumping at night from SCADA	1	21.62	1108.51	$83	
Transfer pumps	30.9	480	387	Amps meas. by Nelson Elec. Nov. 2003, flow by anal. Pumping at night from SCADA	1	25.69	1106.36	$83	**$166**
Compiled 1/23/2014 by DM									
file: Raid\Raid-2\Water Well Info\Well_Data.xls									

Table 3-16 Comparison of Pumping Energy Costs per MG
Raid\Raid-2\Water Well Info\Well_Data.xls

The ability of the Horizon View system to supply the High and Intermediate pressure zones under normal demands was tested over two days in January 2015.

Figure 3-18 taken from the District SCADA server (Zabbix) shows reservoir levels when supplied solely by the Horizon View source. The graph shows a reservoir variation of about 2.5ft over the period tested. Current PRV settings begin to trigger flow from Horizon View (2.5" PRV 187th Street) when the lead transfer pump at McKinnon wellfield starts.

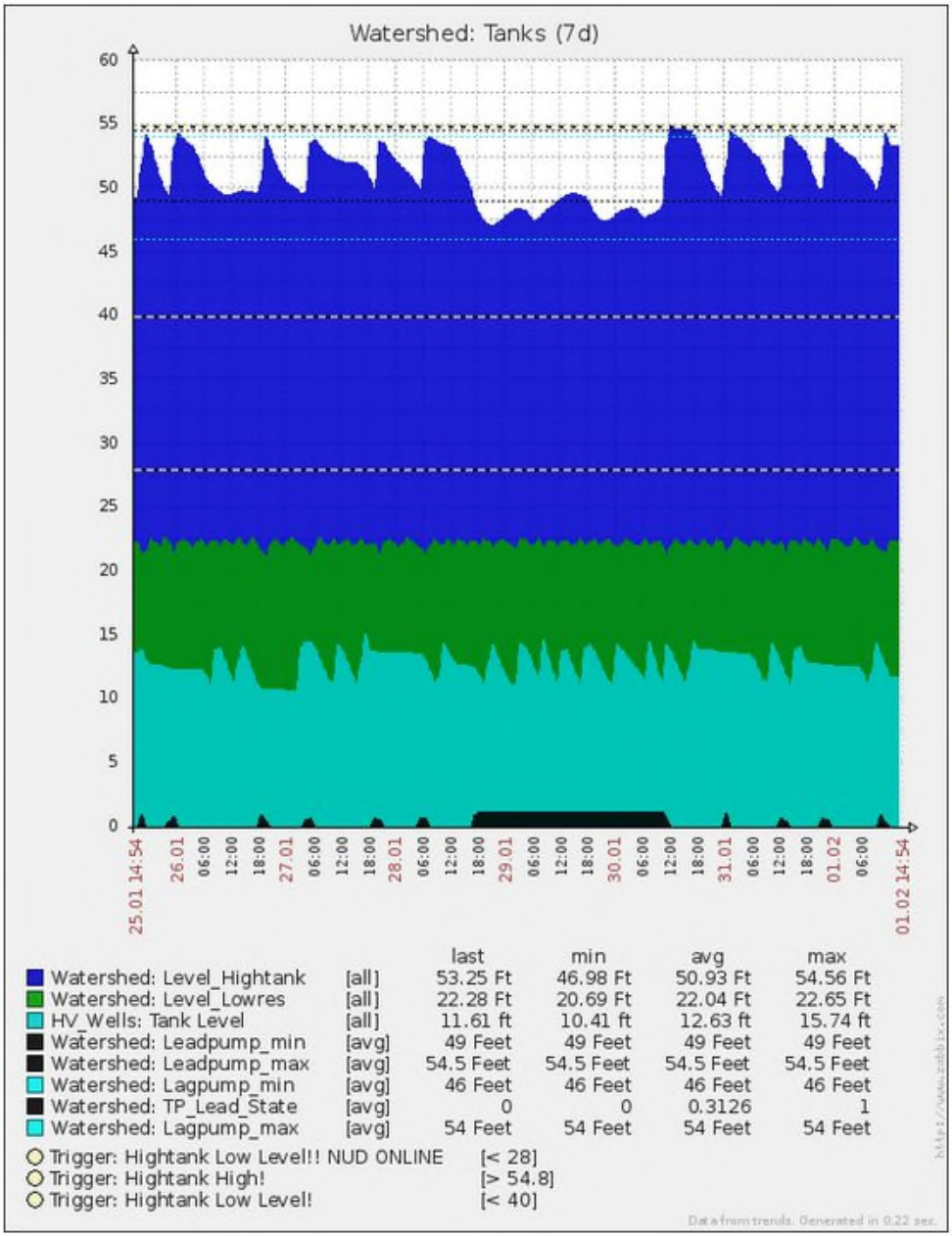


Figure 3-18 Horizon Zone Supply to High Zone Tested in Normal Conditions January 2015

IV. WATER AGING ANALYSIS

BACKGROUND

The main concern with water aging is that the end user may be receiving water that has undergone adverse chemical or biological changes after entering the distribution system. Because the water in the District is produced from its own deep wells (which are free from or low in objectionable elements) no treatment is done prior to distribution. Because the District's water doesn't undergo substantial change between its source and distribution, water age calculation for the purpose of testing for or reducing toxic compounds is of relatively minor importance.

The Districts distribution and storage sizing requirements are primarily dictated by fire flow capacity. Water age in the network is increasing each year as water mains are replaced with larger diameter piping. The District has recently added mixing valves in its storage reservoirs, thus providing efficient water turnover and eliminating dead zones that could promote bacterial colony growth.

MODELING

WaterCAD aging analysis was performed in WaterCAD with normal flow conditions while using the calculated diurnal curve for variable demand. A target maximum water age of seven days or 168 hours was set based on observation of other systems. The resulting data reflects the maximum water age that occurs in a pipe when modeled to equilibrium.

As can be seen in **Table 3-17** below, with the exception of mains at zone boundaries where closed valves or PRVs normally block flow, 90% of the system contains water that is at maximum 120 hours or less.

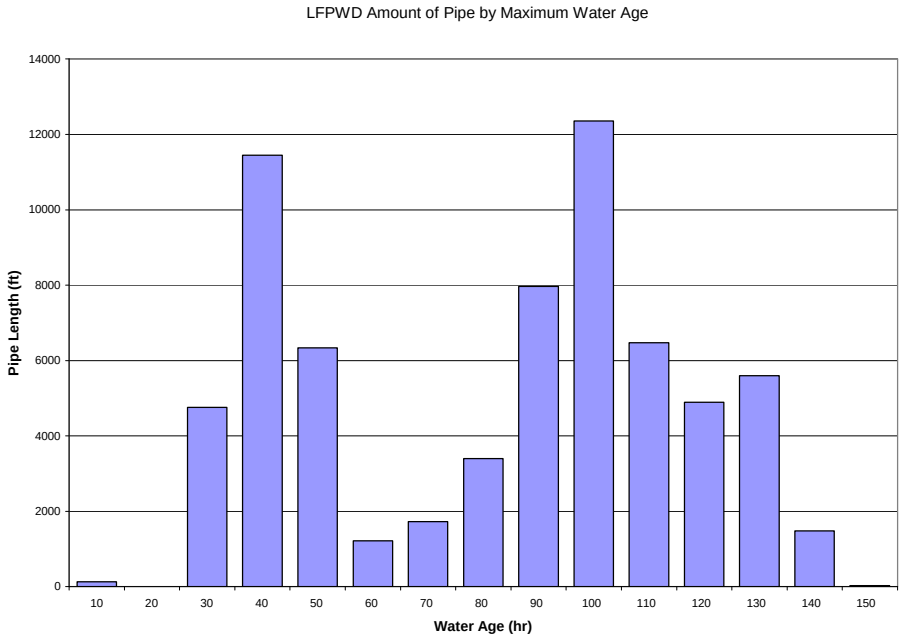


Table 3-17 Water Age in Distribution System

RECOMMENDATIONS:

The following measures are recommended to decrease water age in the distribution system as well as improve overall performance:

1) Replace closed isolation valves at zone boundaries with PRVs or timer controlled valves. There are three such closed isolation valves, and it is noted that these valves are currently recognized in the Districts long term capital improvement program and are slated for replacement with PRVs and reverse flow bypass check valves.

2) Retrofit redundant PRVs with controls that force periodic preference of the redundant loop. (eg. CLA-VAL 97-20 – Dual Stage Pressure Reducing Control Valve with Programmable Timer Control)

3) Retrofit PRVs that remain closed during normal system flows with automatic timer controlled valves that are programmed to periodically release water into the downstream zone.

Additional supportive documents relating to network modeling can be found in the appendices as follows:

Appendix 3-E Network Model – Pipe and Junction Listings

Appendix 3-F Network Model – Unit Demands

Appendix 3-G Network Model – Calibration

Appendix 3-H Network Model – Simulated Capacities

Additional supportive documents relating to network modeling can be found in the appendices as follows:

Appendix 3-E Network Model – Pipe and Junction Listings

Appendix 3-F Network Model – Unit Demands

Appendix 3-G Network Model – Calibration

Appendix 3-H Network Model – Simulated Capacities

PART FOUR WATER RIGHTS, CONSERVATION, RELIABILITY

Part Four summarizes the District's water rights and details plans that are underway to encourage conservation. In addition the District's source, storage and distribution infrastructure are evaluated for reliability with recommendations for improvement in the Capital Facility Plan.

I. WATER RIGHTS EVALUATION

Table 4-1, is a summary of water rights currently held by the District. For more detailed descriptions of each source please refer to source descriptions in previous sections, and to District maps enclosed.

In 2012 the District applied for changes to its water rights to add all wells as additional points of withdrawal for each source including Certificate #498-A which was issued as a surface water right. Changes recently approved by Ecology now permit the District to pool all well sources into a single "wellfield" subject only to the physical capacity of each source. In the report of examination by Doug Woods of Washington Department of Ecology dated January 2, 2014 the rights of surface water Certificate #498-A were amended to 208 gpm (336 ac-ft/yr) based on recorded withdrawals under #498-A which appear in a 1948 groundwater claim declaration filed by Fred B Roberts of Ecology (Department of Natural Resources).

WATER RIGHTS SUMMARY SHEET

File #	*Cert #*	*Qi (gpm)*	*Qa (additive)*	*Qa (Non-additive)*
S1-*01894C	498-A	208	336	
G1-*00835S	767-D	100	162	
G1-*05680C	4019-A	440	704	
G1-*08167C	5839-A	225		360
Total Available	100	**973**	**1202**	**360**

File: Raid2:\System Plan\WaterRights.XLS
Date: 11/6/2014

Table 4-1 Water Rights Information
\\Raid\raid-2\System Plan Work\WaterRights.xls

Table 4-2, also presented in Part III, System Analysis, summarizes the rated capacity of each source, based on draw down tests and operational history, and compares this with the associated water right and the peak system demand. Copies of water rights documents are included in **Appendix 4-A** for reference.

Source Capacity and Demand Information									
	INSTANTANEOUS QUANTITIY WATER					ANNUAL QUANTITY WATER			
	2014	2020	2025	2033	Water Right/Intertie Allowance**	2014	2020	2025	2033
Well Sources (Available Water)	**gpm**		**gpm**	**gpm**	**gpm**	**ac-ft**	**ac-ft**	**ac-ft**	**ac-ft**
Deep Well #1	300	300	300	300	100	162	162	162	162
Deep Well #2	300	300	300	300	440	704	704	704	704
Deep Well #3	350	350	350	350	225	pooled	pooled	pooled	pooled
Deep Well #4 (not DOH approved yet)	0	340	340	340	pooled	pooled	pooled	pooled	pooled
Deep Well #5 (Horizon View #1)	250	250	250	250	pooled	pooled	pooled	pooled	pooled
Deep Well #6 (Horizon View #2)	150	150	150	150	pooled	pooled	pooled	pooled	pooled
Artesian	100	100	100	100	208	336	336	336	336
Total from District sources*	**1450**	**1790**	**1790**	**1790**	**973**	**1202**	**1202**	**1202**	**1202**
Intertie Sources (Available Water)									
Existing NUD Intertie at District WHPA (Emergency - no comitted storage, limited only by physical capacity of intertie valves)	500	500	500	500	*N/A****	Undetermined			
Existing City of Seattle - Tolt System redundant supply Horizon zone Intertie/Meter/PRV at 195th Street (source limited by agreement to 3,500 gpm and by physical capacity of intertie piping to 2,150 gpm)	1200	2150	2150	2150	*3500.00*	Maximum 1 week at 3,500 gpm - Longer duration upon approval			
Future City of Seattle - Tolt System redundant supply Horizon Zone Intertie/Meter/PRV at 193rd Street (existing agreement) 10" DI				2500					
Total Intertie Capacity	**1700**	**2500**	**2650**	**3500**	***3500.00***				
Total System Emergency Capacity	**3150**	**4290**	**4440**	**5290**	***4473.00***	**Not Computed for Sustained Use**			
Demand (Required Water)									
Peak Hour Demand, gal/min	717	784	813	816	*Annual ac-ft/yr*	**233.2**	**242.7**	**245.8**	**252.2**
Peak Day Demand (aka "Max Day Demand), gal/min	538	550	555	564					
Residential Fire Demand, gal/min	1000	1000	1000	1000					
Commercial/Institutional Fire Demand (maximum), gal/min	3500	3500	3500	3500					
Residential Fire System Peak Demand	**1538**	**1550**	**1555**	**1564**					
Commercial Fire System Peak Demand	**4038**	**4050**	**4055**	**4064**					
Edit: 1/22/2015									
Raid2:\System Plan\NetworkHydraulics.xls									
*water rights are aggregated as a single wellfield									
** figures shown in italic are based on intertie									
*** not alloted in NUD Comp. Plan									

Table 4-2 Source Capacity and Demand Information

\\Raid\raid-2\System Plan Work\NetworkHydraulics.xls

II. CONSERVATION AND WATER USE EFFICENCY PROGRAM

This section outlines the District's on-going program of conservation and water use efficiency. It includes a description of the current objectives and progress the District is making towards conservation objectives. Specific conservation measures are outlined that will be implemented in the plan period.

CONSERVATION OBJECTIVES AND WATER SAVINGS PROJECTIONS

Conservation priorities must be sensitive to local needs and water availability. In considering water usage and conservation objectives, the District will remain cognizant of its customers. Lake Forest Park is known for its large forested building lots and dwellings with ornamental gardening and lawns. Conservation will be prioritized first to reduce losses through leakage and meter error, then encourage smart usage, and finally to reduce usage altogether, pending a shortage.

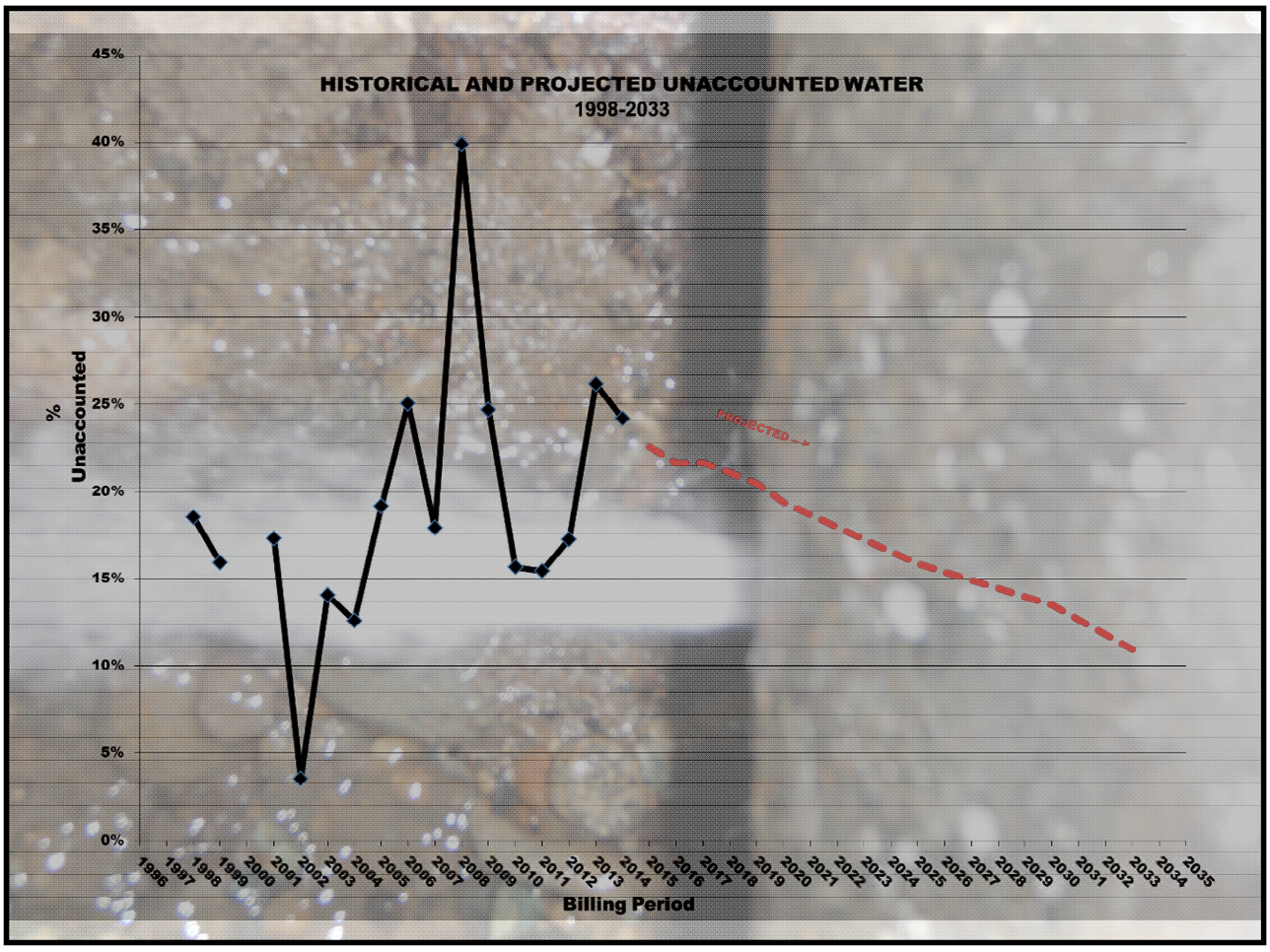
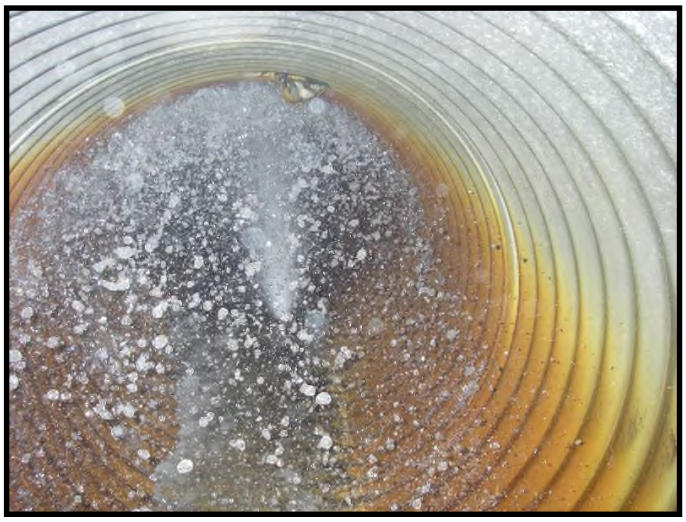


Figure 4-1 Unaccounted Water: Historical & Projected

Figure 4-1 (above) illustrates historical and projected levels of unaccounted water since 1998 and also shows projected Unaccounted Water to 2033. Unaccounted water losses have averaged 22.5% over the past 3 years. Values range from 3.5% in 2002 to about 40% (nearly 50MG) in 2008 when a pipe failure went undetected for months under Ballinger Way at McKinnon Creek culvert crossing. In this case damage to the steel pipe coating and electrolysis reactions with the aluminum culvert pipe corroded a large hole which discharged unnoticed into the creek for months before finally being observed by neighbor children playing nearby. (photo inset)



The District adopted a Water Use Efficiency (WUE) program by Resolution #334 on June 21, 2010 in accordance with WAC 246-290-800.

Objectives of the District's conservation program in this plan are to:

1. **Supply side goal**: Reduce unaccounted water to 10% or less. Successful implementation of this objective will save in pumping costs while also reducing water table draw down due to water lost through leakage.
2. **Water conservation demand side goal**: reduce average customer usage by 0.33% per year for a 2% reduction in the Equivalent Residential Unit (ERU) average consumption over a six year period. Current consumption is 197 Gal/Day/ERU.

WATER USE EFFICIENCY AND CONSERVATION MEASURES

Several conservation measures are also defined in the District's Water Use Efficiency and water loss control program. These are presently being implemented by the District and will be continued through the course of this plan. These include:

1. Replacement of aging and unreliable watermains which are failure prone
2. Annual leak detection of 25% of District mains
3. Quick and efficient response by staff to all known distribution leaks
4. Upgraded telemetry capabilities and reliability for increased monitoring of water production so as to more quickly identify water main failures
5. Bi-monthly calculation of unaccounted water

LFPWD is one of a handful of Group A public water systems in King County that source all water from deep wells. While conservation is a priority, the District does not face the same imperatives for special conservation measures as do surrounding water purveyors who purchase water from SPU. For instance during a period of drought conditions in 2015 the District did not observe any changes in supply or demand that would justify special conservation measures.

III. WATER SUPPLY RELIABILITY AND INTERTIES

This section discusses reliability of the LFPWD water supply system and its components. The ability of the system to reliably supply water at the rated capacities depends on the multiplied reliability of each critical component. Insurers who underwrite buildings rely on industry organizations to set standards for assessing risk. In Washington the Washington Survey and Rating Bureau (WSRB) rates the adequacy of community water supply systems in their ability to reliably provide adequate water for fire protection.

The most recent rating of the District system by WSRB in 2012 assigned a **Protection Class of 4** to the area where LFPWD serves (where 1=best, 10=worst); this rating is favorable and comparable with systems in the surrounding area.

Reliability of supply is also reviewed by Washington State Department of Health (DOH) who carry out periodic field inspections also known as "Sanitary Survey". While focused on water quality these surveys also consider the management capacity and physical infrastructure of each system. The most recent Sanitary Survey of LFPWD was in 2014 and resulted in a favorable review. A copy of the current Sanitary Survey is included in **Appendix 4-B**

SOURCE RELIABILITY

The Districts normal water sources include 2 well fields with 6 operational deep wells and 8 artesian shallow wells. These are the sole source of water for the District in normal operation. In addition to groundwater sources the District has an intertie with the City of Seattle (SPU) and with Northshore Utility District for emergency supply (see Part III). In discussion of source reliability, different scenarios are possible including, short term disruption or capacity limitation, and long term failure. Long term failure could be caused by environmental damage to the sources which is discussed in Part V. Short term failure would result if there were mechanical failures, or interruption in electrical supply.

(a) Production Capacity Limitations

The District's McKinnon Creek deep wells have a reliable production record up to their rated capacity. Excess pumping of the wells has occurred on a few occasions in the last several decades when system demand exceeded 1,200,000 gallons/day, a result of peak usage and leakage losses. Conservation efforts, including pipe replacements, have reduced the observed Peak Day Production to approximately 775,000 gallons/day over this period. Peak day system demand is expected to increase to 812,000 gallons/day, 564 gallons per minute in 2033. This is still within the production capacity and water rights of existing production wells.

A study of the McKinnon Creek well field by Converse, Ward, Davis, Dixon in 1980 Geohydrologic Analysis of Municipal Well Field, reported that the McKinnon Creek well field is judged to have a safe sustained yield of 600 to 750 gpm.

Other well tests combined with operational history have estimated yield of McKinnon Creek wellfield at 1050 gpm for the three deep wells. Additive capacity of all functional wells at McKinnon Creek wellfield is 1450 gpm although this may not be sustainable for more than a few hours due to interference between wells #1,2.

The recent addition of Horizon View wellfield greatly augments source and supply reliability. The combined capacity deep wells #1,2 at Horizon View wellfield was estimated at development to produce 400 gpm (576,000 gallons/day) for concurrent, continuous pumping. Without an additional well source the Horizon View wellfield does not have sufficient capacity to meet the 10 year "peak day" demand of 775,000 gallons/day although historical records suggest it could be adequate to supply peak day demands on most years.

(b) Physical Failure and Water Quality

Physical failure of any one of the District's 6 deep wells or the shallow artesian wells would not cause an immediate water supply emergency, especially considering the potential input of 400 gpm from the Horizon View wellfield. However if there was a failure of McKinnon DW#1 during peak demand months the District could be compelled to rely heavily on McKinnon DW#3 (or McKinnon DW#4 if approved) and this would cause aesthetic concerns due to high iron levels. Note that in spite of high iron levels, the approval of McKinnon DW #4 and the installation of probes and controls to protect well pumps should be completed as soon as possible to protect against over pumping and burnout and to increase local production capacity for fire supression.

Perhaps the greatest threat to the sources is from chemical contamination of the aquifer although this dependency is lessened with recent addition of the Horizon View wellfield. Aquifer protection is discussed in Part Five of the plan.

WATER RIGHT ADEQUACY

Water rights totaling 973 gpm (instantaneous) and 1,202 ac-ft/year are adequate considering the peak demands projected in the foreseeable future. Note that the Seattle intertie is critical to offset peak demands of up to 4,064 gpm during a commercial fire. Without this intertie the District would require significantly more distribution storage to compensate for supply and water rights limitations during a commercial building fire.

PART FIVE - SOURCE PROTECTION PROGRAM

Lake Forest Park Water District is fully committed to protecting its groundwater sources as necessary to provide a perpetual source of *good water naturally*. Furthermore the federal Safe Drinking Water Act (effective 1974) requires every State to develop a wellhead protection program. The following sections describe the District's on-going program for protecting its water well sources in accordance with the structured guidelines outlined by Washington State Department of Health and as required in State law (WAC 246-290-100) for Water System Plan preparation.

I. PLAN OVERVIEW

This source protection plan includes the following elements:

- Description of background information relevant to the water sources of the District including history, geology and hydrogeology of the area.
- A completed susceptibility assessment to describe the relative risk to each source
- Identification of WHPA boundaries with 6mo, 1yr, 5yr and 10yr time of travel.
- An inventory of potential contaminant sources and land use activities.
- A discussion of the management strategy to protect the District's water sources.
- Contingency and emergency response scenarios and mitigative actions
- Supporting information and documentation.

II. HISTORY AND LOCATION

The earliest development of what would become Lake Forest Park Water District began in 1909 by a local logging and road building company. They ran iron pipes down from the springs for drinking water. In 1910 Ole Hanson & Company began community development of the same source, what is now known as the "McKinnon Creek" wellfield, at the time known as "the old springs". Ole Hanson and Co. sold its system to Lake Forest Power, Water and Light in 1913. LFPWL was a subsidiary of North Seattle Improvement Company, the land developer for the local area and the same officers served in both water and development companies. In 1926 the Lake Forest Water Company, privately owned water utility was formed by local residents and took control of the system and made major improvements to what was now known as the "East Watershed". In 1948 King County Water District #83 (a public utility) purchased the network after six years of negotiations with the Lake Forest Park Water Company, at a price $50,000. The pristine character of the McKinnon Creek wellfield was valued from inception and development covenants strictly restricted use of the McKinnon Creek wellfield area for anything but water source and supply. For instance, a 1914 letter from real estate developer Ole Hanson to local resident Nathan Myhre provided for temporary access to the vacant 184th Street corridor with strict provisions limiting the term and use.

Source Protection Program

LFPWD is located wholly within the city of Lake Forest Park population 13,091. Lake Forest Park is a city located on the north end of Lake Washington in northern King County Washington, see location plan **Figure 1-1**. The area is made up of 1.5 square miles of rolling terrain marked by high ridges and steep valleys sloping south. Ground elevations range from a high of 420 feet to 20 feet above sea level near Lake Washington. The District serves 873 residential connections and 11 commercial connections. The service area was originally platted as a residential park, and due to the covenants, the community has remained residential with little commercial and no industrial development. From a groundwater protection standpoint, much of the source protection area is relatively safe from contamination by existing land uses.

III. WELL SYSTEM

The District presently relies upon two well fields which both draw from the same aquifer:

- McKinnon Creek (formerly "East Watershed") located in a 12.6 acre forested property near 187th Street.
- Horizon View "Brightwater Backup Wells" located off 45th Ave. just north of the SPU-Lake Forest Park reservoir and bounded by Horizon View Park. Together, these are the sole source of water supply under normal (non-emergency) conditions.

An understanding of the geology and hydrogeology of the aquifer is essential to characterize its behavior and ensure protection. The following section condenses information from studies of what is referred to as "Lake Forest Park aquifer".

BACKGROUND INFORMATION AND GEOLOGY

The District obtains its water from an aquifer composed of alluvial, sand, and gravel deposits, which are estimated to range between 40 and 100 feet thick. Geology of the aquifer has also been referred to as "Vashon Outwash" in reports. The available information suggest that the aquifer generally flows north-south and the most critical recharge area is north of (and including) Abbeyview cemetery (on Alaska road) in Brier where sands and gravels that make what is known as "Lake Forest Park aquifer" are exposed at the surface without significant overburden of silt or clay layers that would impede infiltration. The north extent of the aquifer and the critical recharge area is not known but is believed to extend at least as far north as the surface drainage boundary at 216th Street.

The Lake Forest Park aquifer is comparatively well documented. There are over 20 water wells with driller's logs as well as at least 3 studies by professional hydro-geologists.

A 1980 study of the system by Converse Ward Davis Dixon, Inc. entitled "Geohydrologic Analysis of Municipal Well Field, Lake Forest Park" evaluated the aquifer characteristics and estimated production capacity of the well field. Some excerpts from the study are included here, and a full copy is included in **Appendix 5-A** for reference.

- *Results of the pump test indicate that the true aquifer thickness is probably between 40 and 50 feet*
- *The rapid, characteristic response of Wells No. 1 and 3 to pumping in Well No. 2 indicates all three wells utilize the same aquifer… We recommend that you continue to divert surface water away from Well No. 3….monitor water quality carefully for signs of bacterial contamination.*
- *Interpretation of the test indicates only a moderately productive aquifer in comparison to others in the Puget Sound region. The aquifer is confined, with a static level between 30 and 40 feet below ground surface….The piezometric surface of the aquifer slopes southward at about the same gradient as the land surface between wells. Using this gradient (about 11:1) , the transmissivity calculated from the pump test, and an assumed*

porosity of 0.2, the velocity of groundwater flow is computed at about ½ mile per year toward Lake Washington. Hydrogeologic maps of the well field vicinity (Smith, 1975, Liesch and others, 1963; Newcomb 1952) suggest recharge of the aquifer occurs in an area extending 3 miles or more to the North. District wells are thus not likely to run dry even during two or three consecutive drought years, although some reduction in capacity might occur at such times.

- *Apparent aquifer transmissivity computed for the well field is about 6000 gallons per day per foot , and the storage coefficient computed from drawdown in Well No. 3…is about $7x10^{-5}$*
- *The drawdown curve for all three wells shows a slight flattening approximately 10 hours into full-capacity pumping, indicating either an increase in transmissivity or a zone of aquifer recharge. The apparent transmissivity computed for this late-time portion of the drawdown curves is about 9800 gallons per day per foot….this effect becomes significant on the order of 1 mile from the well field. This may reflect a change in aquifer thickness and or permeability but is more likely an effect of the high natural gradient of the piezometric surface, the cone of depression can never extend further south than about 10 times the well drawdown.*
- *This extrapolation indicates the safe yield for the well field is between 600 and 750 gallons per minute….If intermittent pumping at high rates is anticipated, extreme care should be taken to ensure pumps will be automatically shut down before water falls below the intake.*
- *Drilling sites northwest or east of the present WHPA and within District boundaries appear favorable for sustained single well yields*
- *Relatively steep natural gradient exists in the pietometric surface limiting southward migration of the cone of depression to about 10 times the well drawdown.*
- *Velocity of groundwater flow is about ½ mile per year toward Lake Washington*

More recently the aquifer was studied by King County as it related to Brightwater treated effluent tunnel constructed from Woodinville to Edmonds along the 195th Street corridor. A 2005 report prepared by CDM Consulting and Aspect Consulting for the County entitled "Summary of Lake Forest Park Hydrogeologic Investigations – Geotechnical Services for the Brightwater Conveyance System Contract No. E23007E, Task 162". This study confirms several assumptions of the 1980 study by Converse and provides additional information that characterizes the aquifer. The report describes the findings of test drilling along 195th Street and other wells which demonstrated area boundaries and presented a vertical profile of the aquifer in East-West and North-South directions. Some excerpts of the study are included here and a full copy is included in **Appendix 5-B** for reference.

- *Interconnected sand and gravel bodies form the LFPWD aquifer*
- *The main aquifer body trends generally south-southeast. East-west extent is more limited, approximately bounded by Lyon Creek to the west and following a north-northwest trending line from 62nd Ave. at the shore of Lake Washington to 55th Ave. at 195th Street.*
- *Aquifer is wedge shaped, becoming thicker to the north… and thinning to the east and west*

- *Along thickest north-south centerline, the aquifer is over 130 ft thick beneath 195th St.*
- *High degree of interconnectedness of the sand and gravel channels above about elevation 200 feet results in the high yields that are characteristic of the LFPWD aquifer*
- *Glaciolacustrine, glaciomarine, and glacial diamicton deposits composed of hard silts and clays limit downward migration of groundwater from the aquifer and form the regional aquitard below the LFPWD aquifer*
- *Horizontal hydraulic conductivity of the LFP Aquifer is estimated at 20 ft/day …using equivalent aquifer thickness of 80 feet*
- *Transmissivity of the LFP Aquifer varied from 2,000 to 16,000 gal/day/ft. Average is estimated at approximately 7000 gal/day/ft*

In 2009 the District drilled and tested two test/production wells at Horizon View, immediately north of the Seattle reservoir. The aquifer system was characterized in a report by Robinson-Noble Saltbush. Some excerpts of this report are offered below are helpful in further describing the LFP aquifer system:

- *Transmissivity is approximately 10,000 gal/day/ft ranging to 19,000 gal/day/ft east of the Horizon View wells*
- *Storage coefficient is calculated as 0.0001 (highly confined)*

Figure 5-1 is a north-south profile of the LFP aquifer that is constructed from well logs and hydrogeologic study information as noted above. Some observations of this profile are noted here:

- *Average north-south gradient of potentiometric elevation over a 10,400 feet distance from BW-7 to McKinnon Creek wellfield is about 0.0096%. South of McKinnon Creek wellfield the gradient is about 10% marking the transition to "unconfined" as it nears Lake Washington.*
- *Aquifer is completely unconfined in the recharge area north of Abbeyview Cemetery but has about 340 feet of confining layers at Horizon View wells and 140 feet at McKinnon Creek wellfield.*
- *Thickness of aquifer core ranges from 75 to 150 feet over the 3+ miles north of Lake Washington and appears to taper out on the east and west boundaries*
- *Brightwater tunnel (under 195th Street) is about 50 – 60 feet below aquifer at test well E-115A (a point on the north-south profile).*

***Figure 5-2** is an east-west profile of the LFP aquifer at 195th St. that was constructed using test bores from the King County Brightwater tunnel. Some observations of this profile are noted here:*

- *Aquifer is composed of several interconnected "lobes"*
- *East-west width is about 1000 feet at 195th Street*
- *Design HGL of Brightwater conveyance tunnel is consistently below the potentiometric elevation of the aquifer. The difference is about 150 feet near TW-202*

Figure 5-1

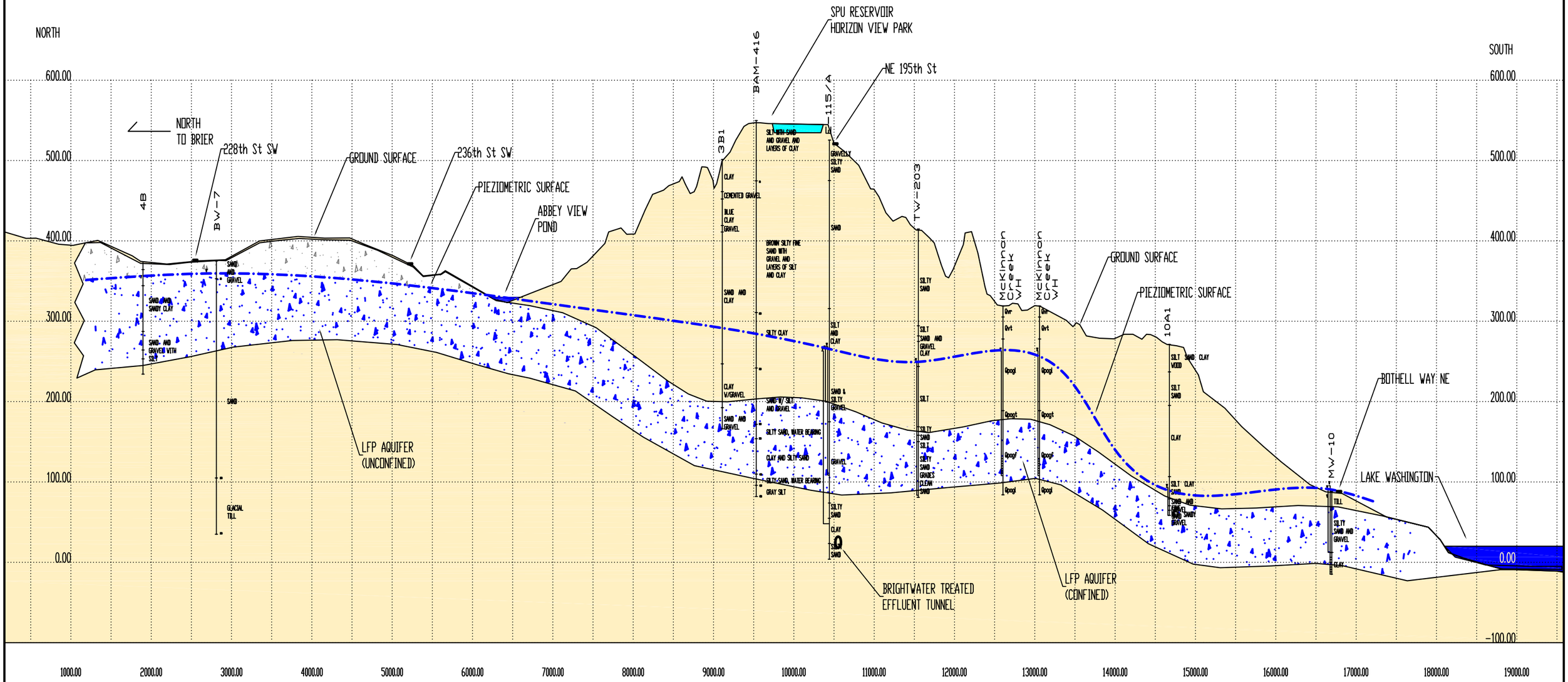


FIGURE 5-1

LAKE FOREST PARK AQUIFER PROFILE - (NORTH TO SOUTH)

November, 2014 - (Geological data from well logs and regional studies by others, Vertical Datum NAVD88)

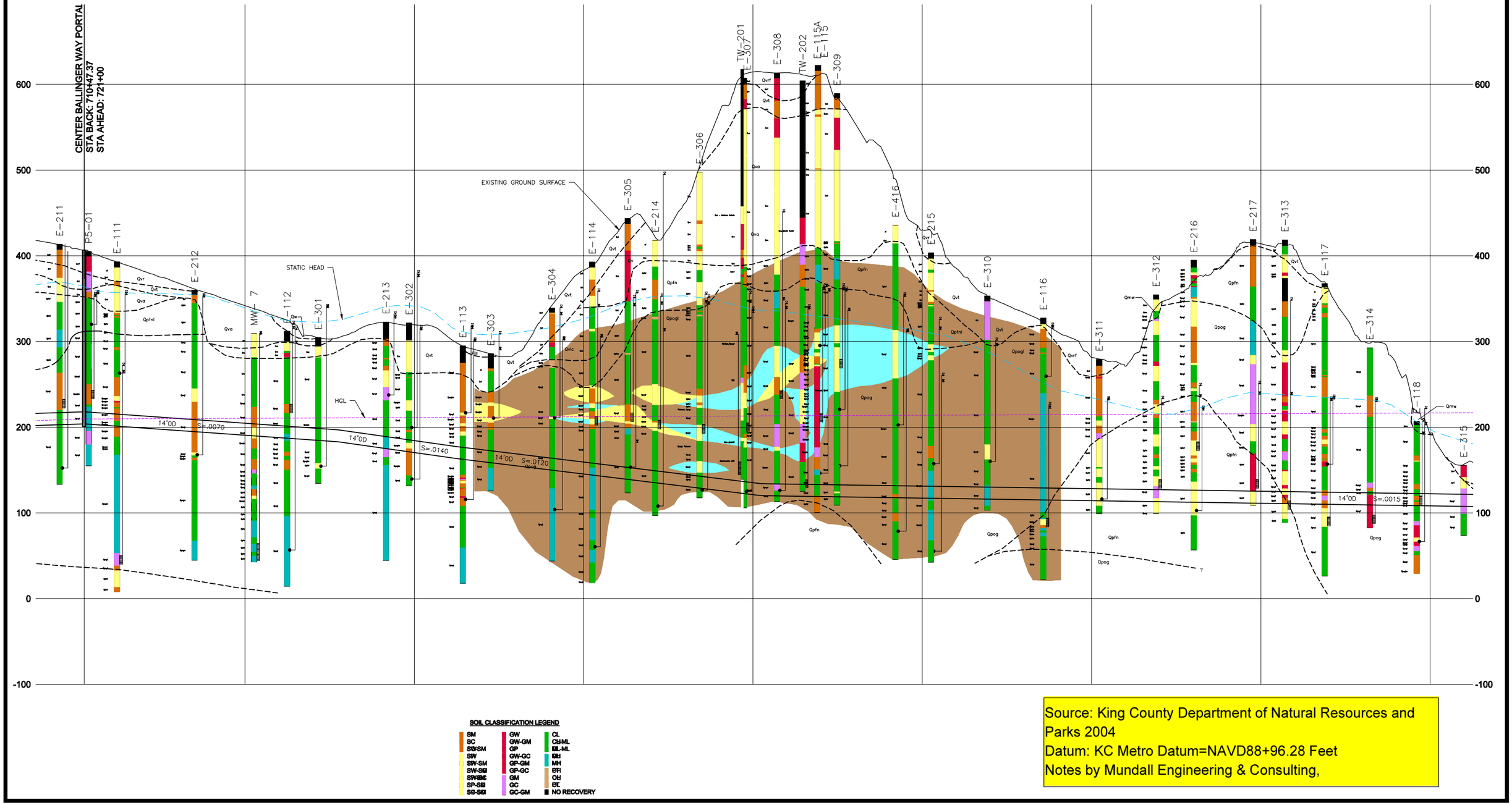
LAKE FOREST PARK WATER DISTRICT

GOOD WATER NATURALLY

MUNDALL ENGINEERING & CONSULTING
P.O. Box 799, Sumas Washington 98295
P.O. Box 50, Lytton, B.C. V0K 1Z0
Bus. (250)-455-0085 Cellular (360)-319-1285
FAX (250)-455-2276 E-Mail DanMMundall.com (800)-313-9705

East - West Profile LFP Aquifer at 195th Street
Showing King County Brightwater Tunnel

Figure 5-2



Source: King County Department of Natural Resources and Parks 2004
Datum: KC Metro Datum=NAVD88+96.28 Feet
Notes by Mundall Engineering & Consulting,

Basic information for each groundwater source is summarized below. More detailed information about the wells can be found in Part Three of this document.

SOURCE DESIGNATION S0-5: MCKINNON CREEK ARTESIAN WELLS

SO-5 consists of eight artesian aquifer wells less than 30 feet deep that continually each flow at approximately 10 gallons per minute. Water is collected from each well in a riser tube with a pitless adapter about 3ft below ground surface and flows to a collection manifold before entering a concrete cistern before being pumped to the Low Zone reservoir.

SOURCE DESIGNATION S0-6: MCKINNON CREEK DEEP WELLS 1,2,3

SO-6 consists of three drilled wells, wells 1, 2, and 3 that are over 200 feet deep and depth to first open interval is about 144 feet. Access to the wells is controlled by a locking gate and a fenced enclosure. A well log is available for McKinnon Creek deep wells #2 and #3. These are included in **Appendix 5-C**, "Well Construction Reports".

- McKinnon DW # 1 is an 8" well drilled to a depth of 216 feet. Well #1 does not flow at the surface; it has a static water level of 31 feet below the surface as measured in January 1998. A surface seal of cement is installed to a depth of 20 feet below the surface. This well has produced over 68 million gallons per year on average (2004 – 2014) and is the principal production well of the District.
- McKinnon DW #2 is an 8" well drilled to a depth of 190 feet. Well #2 does not flow; it has a static water level of 25 feet below the surface as measured in January 1998. A surface seal of cement is installed to a depth of 20 feet below the surface. This well is close to DW#1 and there is interference when pumping these together. In addition there is a high amount of resistance in the well screen so DW#2 is usually operated in the winter when system demand is lower.
- McKinnon DW #3 is a 12" well drilled to a depth of 161 feet. Well #3 is artesian; it has a static water level of three feet above the surface as measured in January 1998. A surface seal of cement is installed to a depth of 20 feet below the surface. DW#3 has shown a high iron content and is usually accorded low priority to minimize iron levels.
- ***Note: there was a nomenclature change regarding McKinnon DW#1,2 – please see Part Three of this document for more information.***

SOURCE DESIGNATION S0-8 HORIZON VIEW WELLS 1,2

Well logs are available for Horizon deep wells #1,2. S09 consists of two drilled wells which are each about 468 ft deep with depth to first open interval over 375 feet. Well logs are included in **Appendix 5-D** and summary information regarding the wells is listed here:

- Horizon DW #1 is a 16"/12" well drilled to a depth of 468 feet. Static water level was 284.7 feet below ground surface. A surface seal of clay was installed to a depth of 50 feet below ground surface and there is an 8" screen 375.5 – 396.5 BGS and 440.0 – 455.5 BGS. This well was rated at about 300 gpm continuous pumping.
- Horizon DW #2 is a 16"/12" well drilled to a depth of 468 feet. Static water level was 291.6 feet below ground surface. A surface seal of clay was installed to a depth of 50 feet below ground surface and there is an 8" screen 377.0 – 402.5 BGS and 440.0 – 450.5 BGS. This well was rated at about 250 gpm continuous pumping.

AQUIFER SUSCEPTIBILITY

This section discusses the susceptibility rating of each source, and hence the exposure risk from contamination.

GENERAL INFORMATION

The susceptibility assessment is used by WSDOH to classify the vulnerability of each water source. Vulnerability is composed of two factors, the physical susceptibility, as noted below, and the source's risk of exposure to contaminants. The risk of exposure to contaminants is determined by whether or not contaminants were used in the area, or detected in the water supply.

Susceptibility is determined by conditions that affect the movement of groundwater, and thus contaminants, from the land surface into an aquifer. Susceptibility is a qualitative measure of how quickly and how far groundwater must travel to reach a water source, either well or spring. Confining units are critical to susceptibility determinations. In general, a confining unit is any earth material that does not readily transmit water. Typically layers of clay or shale may act as confining units, depending upon their thickness and lateral extent. When confining layers are present, wells are less susceptible to contamination because they impede the movement of contaminants from the land surface into underlying aquifers.

Susceptibility Rating for McKinnon Creek Deep Wells (S-06)

Based upon information provided in the Ground Water Contamination Susceptibility Assessment Survey Form (**Appendix 5-E**), the State has classified the McKinnon Creek deep wells as having a rating of "M", or "moderately susceptible". The water bearing strata consists of alluvial deposits of coarse sands and gravel overlaid by a confining layer of silts and clay.

Susceptibility assessment of "Moderate" is designated by WSDOH where the source is:

- unconfined aquifer (>150 ft deep),
- nitrates < 5 mg/L
- no VOC detections
- no inorganic MCL violations
- adequate well construction based on recorded age, region & type of construction
- vulnerability data cross checked with DW database
- review of 6 month & 1 yr. time of travel shows no critical contaminant sources warranting immediate investigation

Susceptibility Rating for McKinnon Creek Shallow Artesian Wells (S-05)

The artesian well field has a susceptibility rating of "H", or "highly susceptible". However it is not categorized as GUI (Groundwater Under Influence). This rating is based upon the knowledge that they are relatively shallow and could be recharged locally with surface water. Temperature, pH, turbidity, and production capacity are very constant and mirror levels found in the deep wells as can be determined from sampling and production records which are summarized in the System Plan. Detailed sampling records are maintained by the District.

Susceptibility assessment of "High" is designated by WSDOH where the source is:

- unconfined aquifer (<150 ft deep), or
- source construction is questionable or unverified, or
- source water quality has
- nitrates > 5 mg/L but <10 mg/L or
- other inorganic MCL violations
- no VOC detections
- vulnerability data cross checked with DW database

Susceptibility Rating for Horizon View Deep Wells 1,2 (S-09)

Based upon information provided in the Ground Water Contamination Susceptibility Assessment Survey Form (**Appendix 5-F**), the State has classified the newly constructed Horizon View deep wells as having a rating of "L", or "Low" susceptibility. The water bearing strata consists of alluvial deposits of coarse sands and gravel overlaid by several confining layers of silts and clay over 270 feet in thickness. The Horizon View wells are also constructed in accordance with modern standards with the additional benefit of a 50 foot clay seal and are therefore less likely to be affected by a surface contamination source.

Susceptibility assessment of "Low" is designated by WSDOH where the source is:

- confined aquifer
- unconfined, excessively deep aquifer (>250 ft) and has
- nitrates < 5 mg/L
- no VOC detections
- no inorganic MCL violations
- adequate well construction based on recorded age, region & type of construction
- vulnerability data cross checked with DW database
- Review of 6 month & 1 yr. time of travel shows no critical contaminant sources warranting immediate investigation

IV. IDENTIFICATION OF THE WELLHEAD PROTECTION AREA (WHPA)

Several variables are useful in understanding and describing an aquifer source system. There is considerable variation in terminology used by various authorities but the following terms are used here to describe the LFP aquifer well source system:

- **Well Capture Zone of Influence** – source water path-lines to wells
- **10 year WHPA (Well-Head Protection Area)** – practical boundary for source protection management
- **Probable east-west boundaries** of the LFP aquifer
- **Aquifer 50 ft thickness line** (helps delineate core of aquifer)
- **Aquifer surface catchment buffer zone** (area where rainfall would collect and flow on the surface towards the WHPA.
- **Potential Contamination Sites**

BACKGROUND

Recharge of aquifers occurs through infiltration of precipitation in areas where the aquifer lies at or near the surface, or where confining units are absent or thin enough to allow groundwater to leak through the confining layer into the aquifer. Ideally, all land areas that contribute recharge to the aquifer would be targeted for inclusion in the WHPA. Unfortunately, the identification of precise recharge areas for wells is a technical and time consuming process. Further, once identified, they often cover vast amounts of land, and therefore become difficult to manage. To remedy these problems, the WHPA program focuses protection efforts near the wellhead. Washington State Department of Health has defined management zones based on the horizontal distance from the wellhead. The following management zones are defined by WSDOH for well source systems:

- **Sanitary Control Area** – up to 100 feet from wellhead (considered zone of immediate risk from microbial contamination, especially through well casing)
- **Zone 1 – 6 month** time of travel (risk of microbial contamination due to survival of microorganisms)
- **Zone 1 - 12 month** time of travel (risk of microbial or direct chemical contamination) – increased need for contaminant source identification
- **Zone 2 – 5 yea**r time of travel (risk of chemical contaminant)
- **Zone 3 – 10** year time of travel (important for community planning)

METHODS OF DELINEATING THE WELL-HEAD PROTECTION AREA

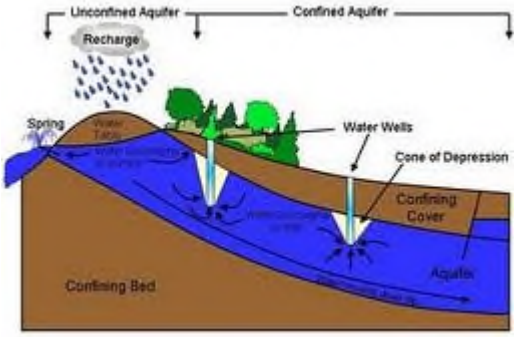
The following are useful in understanding the various zones described in **Figure 5-3** and how the various zones were developed:

Well Capture Zone of Influence - source water path lines to wells

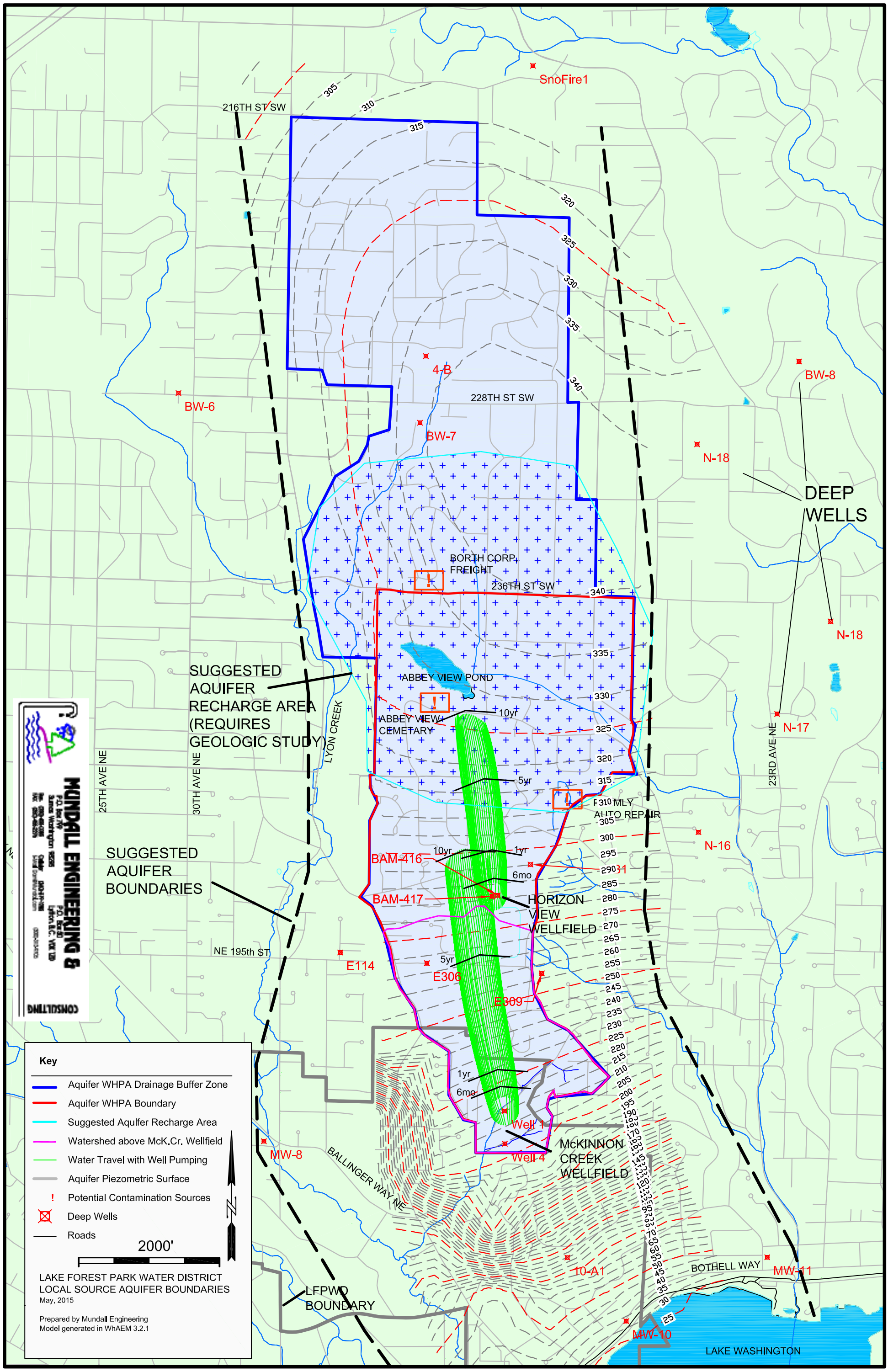
WhAEM 2000 was used to generate flow path-lines for each wellfield using static well levels from Washington Dept. of Ecology database in the area of interest and other variables which were obtained from previous studies as well as known source withdrawal rates, transmissivity and storage coefficient.

WhAEM2000 is a public domain and open source general purpose ground-water flow modeling system, with strengths in representing regional flow systems, and ground water/surface water interactions. It was initially designed to facilitate capture zone delineation and protection area mapping in support of the State's Wellhead Protection Programs (WHPP) and Source Water Assessment Planning (SWAP) for public water supply wells in the United States. WhAEM 2000 is developed and maintained by the US EPA, Office of Research and Development.

In creation of the model some difficulty arose due to inhomogeneities in the aquifer. However with adequate corrections using program features of "line sinks" a model was obtained that closely matched observed static water levels and having a RMS error value of less than 28.6 for all reference wells in the system. The program was set for 10 years time of travel and generated contours and flow path-lines as indicated in **Figure 5-3.** Note the geometric proportions of path-lines for both wellfields show a strong north-south elongation with a width of about 570 feet and length over 3,270 feet. This elongation is a result of the high pietometric gradient or downward "slope" of the aquifer toward Lake Washington.



The LFP aquifer is believed to be un-confined from Abbeyview Cemetery and northward with the aquifer layer of sands and gravels typically several inches or at the most a few feet of the surface. This area is more vulnerable to contamination. However there is an added benefit of distance from source wells which could allow for attenuation and dilution of contaminants before entering the potable water supply. Time of Travel to the Horizon wellfield is estimated at 10 years from Abbeyview pond.



LAKE FOREST PARK WATER DISTRICT
AQUIFER BOUNDARIES

FIGURE 5-3

Rough calculations were made using Darcy's equation for continuity to estimate base flow in the aquifer as it nears Lake Washington, just south of the McKinnon Creek wellfield. The results suggest that given:

- Transmissivity = 6,000 gpd/sq-ft (Converse 1980)
- Porosity (n) = 0.22 (various sources – typical)
- Aquifer effective area 400ft x 50ft = 20,000 sq-ft
- Slope = 0.093 ft/ft (based on 170ft drop in 1830ft south of McKinnon wellfield)
- BASE FLOW = 462 MG/year.
- LFPWD annual withdrawals (deep wells) are about 90 MG/year

Overall impact of LFPWD withdrawals is approximately 16% of the total aquifer delivery when base flow to Lake Washington is included.

10 year WHPA (Well-Head Protection Area) – practical boundary for source protection management

The flow lines generated by WhAEM are useful but there is enough uncertainty in the data that a larger buffer was selected to delineate the WHPA.

A larger buffer envelope that encloses the Well Capture path-lines was prepared based on the possible impact of variations in the source data on WhAEM results as well as topographic and geological considerations. The composite WHPA for both wellfields is about 3,000 feet wide (east-west) and about 8,000 feet long, extending from the south end of the McKinnon wellfield northward and slightly west to the north end of Abbeyview pond at 236th Street in Brier.

Probable east-west boundaries of the LFP aquifer

A wider boundary delineates an east –west boundary of the LFP Aquifer. This boundary was suggested by King County (2005) after their study of the aquifer and is based on numerous test holes. The King County aquifer boundaries stopped short of Horizon View. However the results of pumping tests by Robinson Noble (2009) in development of the Horizon View wells, as well as the Converse (1980) report suggest a continuation of the east-west boundaries northward perhaps 2.6 miles north of the McKinnon wellfield to 218th Street.

Aquifer 50 ft thickness (helps delineate core of aquifer

The core area of the LFP Aquifer is delineated by the 50 feet thickness line which is also extrapolated from King County (2005)

Aquifer surface catchment buffer zone (area where rainfall would collect and flow on the surface towards the WHPA.

A suggested catchment buffer zone is proposed based on analysis of terrain and probable runoff patterns in the area. Note that the catchment buffer zone extends as far south as the McKinnon Creek wellfield. However aquitard layers of silt and clay would limit infiltration in most areas south of Abbeyview Cemetery. Therefore assuming a catchment area beginning at Abbeyview Cemetery there would be approximately 1000 acres. The resulting catchment area could be expected to receive about 550 MG/year given about 20 inch/year infiltration.

POTENTIAL CONTAMINANT SOURCE INVENTORY

This section describes the methods and findings of the Contaminant Source Inventory survey. State rule (WAC 246-290-135) requires all Group A systems (including community, non-transient non-community and transient non-community types) to conduct an inventory for potential contaminant sources within their source water protection area. This constitutes part of state wellhead protection and/or watershed control requirements.

METHODS

Database inquiries were made for the District area via both the DOE and EPA's Priority Action List, superfund sites.

1. Field surveys were also conducted in order to inventory potential sources of contamination. Windshield and walk through surveys were completed to examine land use activities within the entire WHPA buffer zone. The in-field inventory was conducted by Mundall Engineering staff during the summer of 2014.
2. Several Potential Contaminant Sources listed in the District's existing source protection program were also carried over for inclusion in the current PCS list.

FINDINGS

Detailed findings of these studies are included in **Appendix 5-G** and identify land use activities that may pose threats to groundwater quality. The surveys indicate that the WHPA has relatively few sources of potential hazard to groundwater water quality for a suburban water supply. There is little business activity within the 10 year zone of contribution due to the fact that the community is residential. The entire area is served by five public wastewater systems and there are no known on-site septic disposal systems in the WHPA.

Table 5-1 summarizes Potential Contamination Sources (PCS) that were identified through the survey. About 15 PCS were identified within the 10-year WHPA boundary for McKinnon Creek and Horizon View wellfields. These were obtained through database inquiries, field surveys and review of previous source protection plan (2005).

A graphical data base summary of potential contaminant sources was also developed as an overlay in Google Earth and these are also presented in **Figure 5-3**.

Figure 5-4 offers a detailed map of the McKinnon Creek sanitary control area. **Figure 5-5** is a detailed map of the Horizon View sanitary control area.

Table 5-1 Potential Source Contaminant Inventory

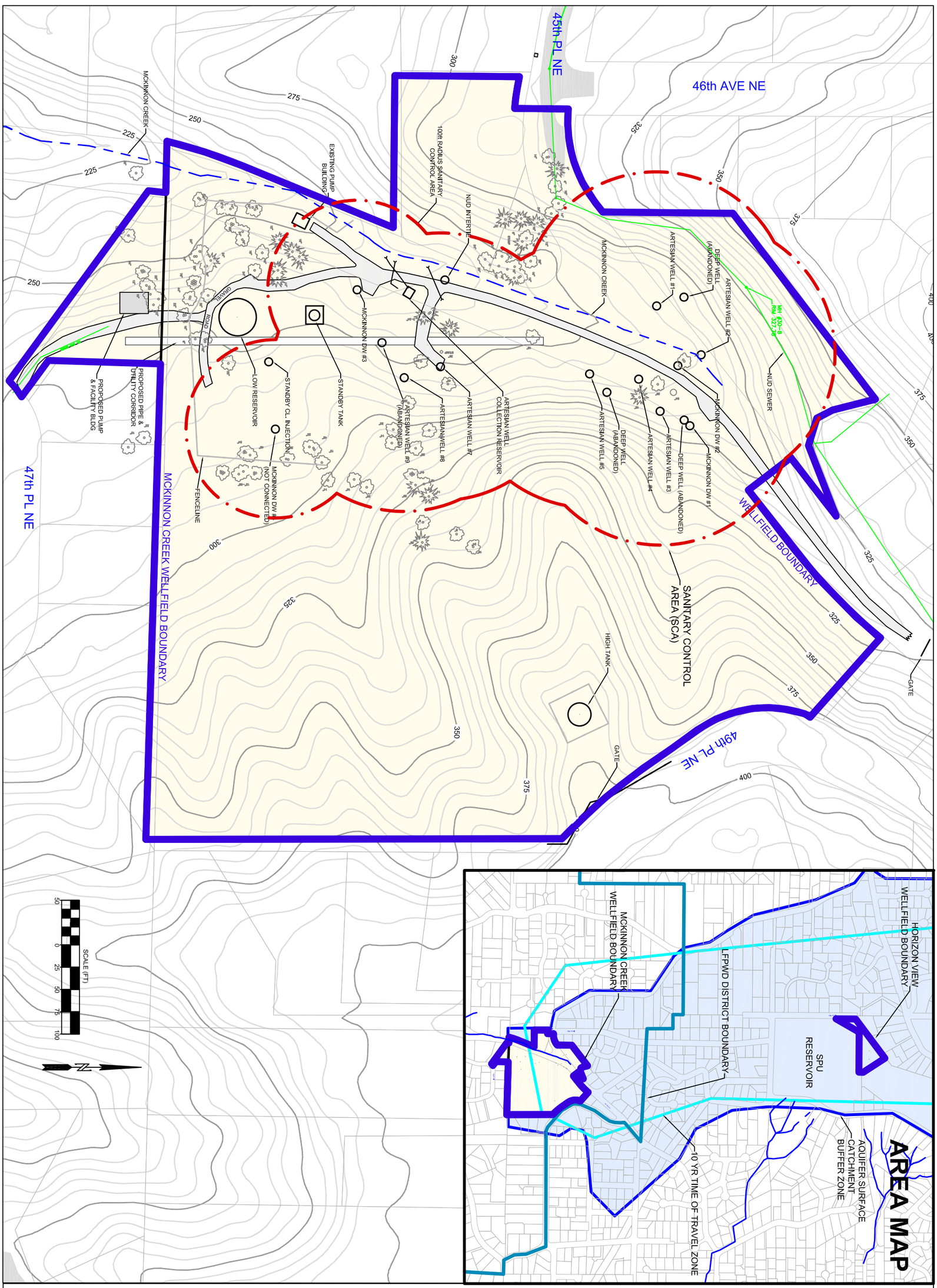
Raid-2\System Plan Work\Source Protection\Potential Water Source Contaminant Inventory Summary – LFPWD.xls

Potential Water Source Contaminant Inventory Summary - LFPWD

9-Apr-15

Potential Water Source Contaminant Description	Facility /Activity /Contaminant Class	McKinnon Cr. WHPA Time of Travel Risk Class	Horizon View WHPA Time of Travel Risk Class	Location / Address	KC/Snohomish Tax Parcel #	Listed in State/Federal databases?	GIS - Google Earth Listing	Date Identified	Risk Management Action Plan
Abandoned Water Well Well - covered with concrete but improperly abandoned	Microbial	Sanitary Zone	N/A	McKinnon Cr. Wellfield (see map) about 8ft South of DW#1		No	No	2014	Schedule proper abandonment
Abandoned Water Well Well - piping fully exposed	Microbial	Sanitary Zone	N/A	McKinnon Cr. Wellfield (see map) about 25ft west of SW#2			No	2014	Schedule proper abandonment
Norshore Utility District sanitary sewer	Microbial	Sanitary Zone	N/A	McKinnon Cr. Wellfield about 70 feet West of DW#2 and on steep slope above.		No	No	2005	Written agreement with NUD. Includes warning light if sewer flooded. Sewer has been poly lined to mitigate risk
City of Lake Forest Park - Road Drainage/street maintenance - runoff into McKinnon Cr. Wellfield	Microbial / also risk of accident spill - fuel, oils	Sanitary Zone	N/A	McKinnon Creek is a potential hazard as it carries drainage from uphill areas north of the WHPA.		No	No	2005	Alternate source with Horizon View allows reduced dependency on McKinnon Cr. Wellfield in case of a contamination event. Wellhead Protection Area signs will increase awareness
City of Lake Forest Park - Road Drainage/street maintenance - runoff into recharge area near Abbyview Cemetery	fuel, chemical spill	> 10 years	10 year	Alaska Road		No	No	2014	Wellhead Protection Area signs to increase awareness
City of Brier - Road Drainage / street maintenance - runoff into recharge area near Abbyview Cemetery	fuel, chemical spill	> 10 years	5 - 10 year	Alaska Road		No	No	2014	Wellhead Protection Area signs to increase awareness
Abbyview Cemetery fuel storage and Formaldahyde used in embalming, Dalapon, Lindane, Nitrate, Nitrite.	fuel, chemical spill	> 10 years	5 - 10 year	3600 Alaska Road		EPA 110005375398	Yes	2014	Facility is responsible to State/Federal authorities for pollution comtrols. District should develop stentinel well north of Horizon View wellfield to identify any pollution.
Borth Corp - trucking business	fuel, chemical spill	> 10 years	10 year	3716 235TH PL SW, Brier, WA 98036		EPA 110005321188	Yes	2014	Facility is responsible to State/Federal authorities for pollution comtrols. District should develop stentinel well north of Horizon View wellfield to identify any pollution.
Residential - fertilizer/pesticide application - distributed throughout WHPA zones	VOC, nitrates	6 months	1 - 10 year	throughout		N/A		2005	Public education
Parmly Property - Automotive Repair Shop	VOC, petroleum products		5 - 10 year	20137 47TH AVE NE, Lake Forest Park, WA 98155		EPA 110015571308	Yes	2014	Facility is responsible to State/Federal authorities for pollution comtrols. District should develop stentinel well north of Horizon View wellfield to identify any pollution.
Abandoned residential well	bacterial	6 months	N/A	18496 43rd Avenue NE		No		2005	Contact property owner, educate regarding risk. Note however that this well is west of McKinnon Creek and unlikely in the zone of influence.
King County - Brightwater tunnel for treated effluent	nitrates/other. Most likely risk is aquifer depletion	5 - 10 year	N/A	under 195th Street		??	Yes	2014	Tunnel was constructed in 2010. The District has a mitigation agreement that includes long term monitoring and reporting.
King County - 5 Monitoring wells along tunnel alignment	surface runoff - unknown risk	5 - 10 year	N/A	under 195th Street				2014	District has agreement with King County for maintenance of these wells
Horizon View Park - Abandoned Well from Nike missile base water supply was located during survey of potential contaminant sites using aerial photography and metal finder	surface runoff, pesticides, bacteria	>10 years	6 months - 1 year	inside of LFP Horizon View Park, about 25 ft south of ball fence		No	Yes	2014	District needs to present to the City of LFP for discussion. Possible retrofit of well to meet current standards and re-deployment as sentinel monitoring well
Horizon View wellfield - pedestrian access	surface runoff, pesticides, bacteria	> 10 years	Sanitary zone	inside of Horizon View wellfield - pedestrian access near wells		No	No	2014	The Horizon view wells are several hundred feet deep with several aquitard/clay layers above the aquifer. Also the wells were constructed with 50 feet clay seal to reduce chance of contamination. District has video surveilance of site against vandalism of wellheads.

Table 5-1 Potential Contamination Sources



LAKE FOREST PARK WATER DISTRICT
MCKINNON CREEK WELLFIELD MAP

Showing Current and Proposed Infrastructure, Various Boundaries, and Topography

FIGURE 5-4

MUNDALL ENGINEERING & CONSULTING
P.O. Box 799, Sumas, Washington 98295
Bus. (360)-855-0886 FAX (360)-855-0276
P.O. Box 50, Lytton, B.C. V0K 1Z0
Cellular (360)-319-1285
E-mail: Don@Mundall.com

LAKE FOREST PARK WATER DISTRICT

GOOD WATER NATURALLY

V. MANAGEMENT STRATEGY

BACKGROUND

A good source protection strategy will ensure that existing threats to source contamination are controlled and that there is a level of awareness by the District and the community that will ensure sensitivity to the future of this resource. Management strategy should comply with applicable laws as well as priorities defined through planning process.

PUBLIC INVOLVEMENT AND EDUCATION

It is not the intention of this plan to interfere with land use activities within the broader Wellhead Protection Area (WHPA). It is; however, important that those people living within the WHPA be aware of their potential and to take reasonable action to prevent contamination. It is also important that residents know who to notify in the event of a spill. Individuals can also impact groundwater quality by failing to properly dispose of household chemicals such as used motor oil and solvents. Residential areas can be a source of contamination when uninformed or uncaring property owners misuse or improperly dispose of hazardous chemicals.

The District has initiated community education and involvement through the following steps:

- Notice of first meeting sent by mail to all residents within the WHPA in December 2014. The mailer included a WHPA map and discussion outlining the need to protect the groundwater from contamination and contact information for reporting emergencies.
- Notice of second meeting sent by mail to all residents within the WHPA in April 2015.
- Public meetings were held on 12/15/2014 and on 4/13/2015 a draft source protection plan was presented and followed by question & answer time and general group discussion. Significant input was received in these discussions and is incorporated into this plan.
- A wellhead protection and communications advisory committee was established by the District in accordance with Washington law to:
    a) assist in obtaining and communicating public input in regard to District's Water System Plan
    b) facilitate cooperation and communication between the District and the community regarding uses and activities that affect the District's well fields.
    c) As legislative authority under Wellhead Protection Planning RCW 43.20.050, 70.119A.060 and 70.119A.080, assist in Wellhead Protection Plan evaluation and communicating public priorities and other public comments
    d) assist with communications and public comment in regard to any ongoing activities set forth in the Wellhead Protection Plan

STATE AND FEDERAL LEGISLATION

Washington State law (WAC 246-290-135) mandates municipal water suppliers to maintain legal and physical control over the sanitary control area immediately surrounding ground water sources. Control over this area can be through ownership, an easement or a legal "covenant"

which allows the water system to limit land uses. For further information please refer to DOH publication #331-453 "Sanitary Control Area Protection" October, 2010, and "Covenants for Public Water Supply Protection #331-048.

Federal laws developed in the wake of 9/11 include "Public Health Security and Bioterrorism Preparedness and Response Act of 2002", Public Law 107-188. This law requires community water systems (CWS) serving more than 3,300 persons to submit a "Vulnerability Assessment" and develop Emergency Response Plans (ERP) for protection of critical infrastructure. LFPWD currently serves under 3,300 persons – however, systems serving under 3,300 persons are still encouraged to comply with these provisions. A vulnerability assessment has been completed and notice has been sent to Department of Health .

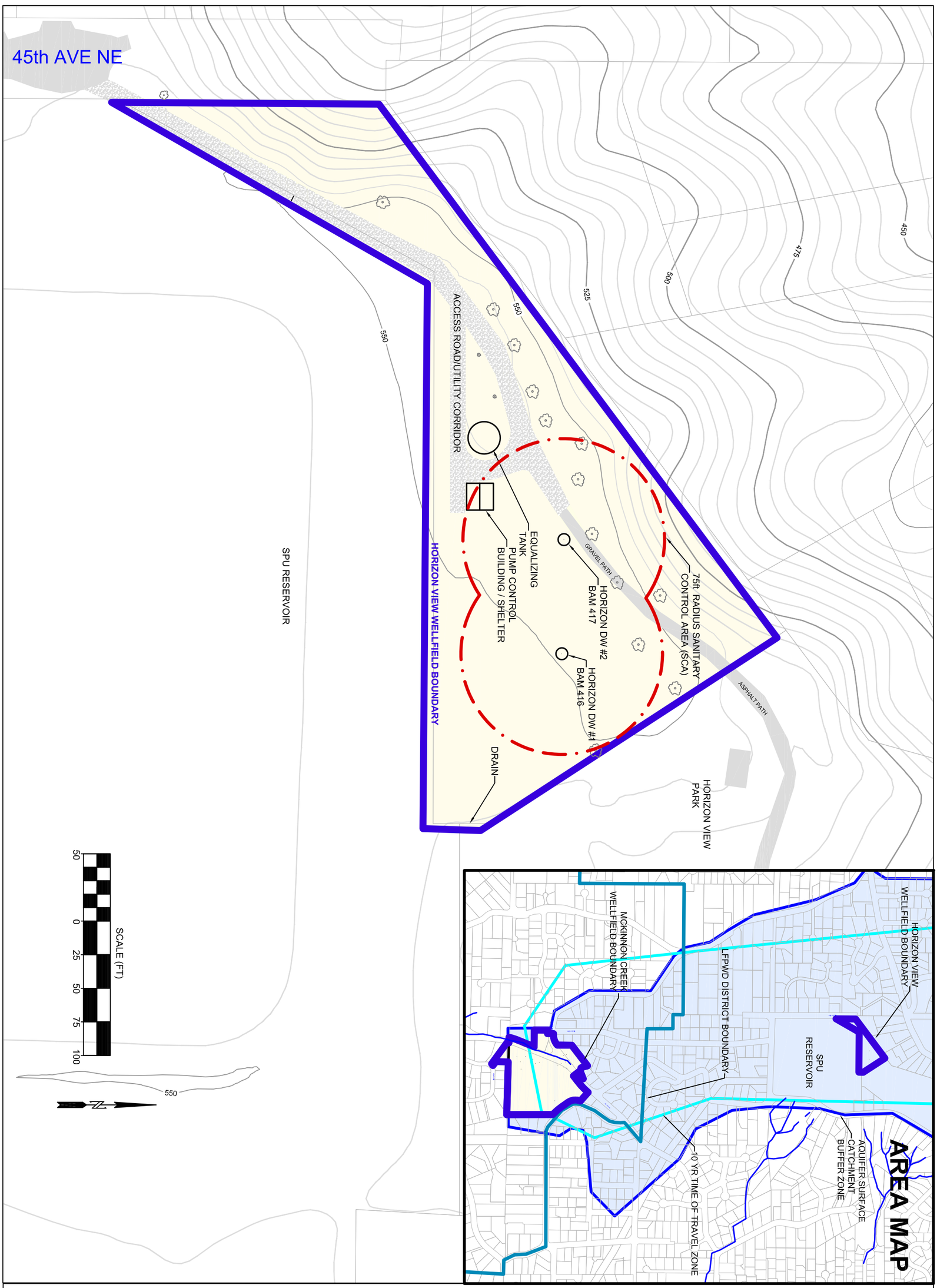
MCKINNON CREEK WELLFIELD SANITARY CONTROL AREA (SCA)

Access to McKinnon Creek wellfield is limited via a locked gate and a fenced area that contains the wells and the reservoirs. However fencing and gates are vulnerable and need to be restored. Perimeter fencing needs to be improved and re-constructed around the McKinnon Creek wellfield. Negotiations with the City of Lake Forest Park in regard to a public trail are ongoing and may change the District's fencing plan. As a second line of defense the District also operates security cameras in the McKinnon Creek wellfield and plans are underway to expand their deployment.

The District is working to clarify its control over the required 100 foot sanitary set back in a portion of the SCA that lies in platted, but undeveloped right-of-way. The validity of the right-of-way is disputed. In 2014 the District initiated a "Quiet Title" action in King County Superior Court to attempt to resolve this issue.

Another legacy risk is presented with an 8" NUD sanitary sewer which comes within 90 feet of deep well #2. In October 2000 NUD and LFPWD agreed to manage this risk. The resulting agreement (see **Appendix 5-H**) does not attempt to eliminate the sewer but instead outlines several mitigating actions including:

1. Water tight and bolted manhole lids in critical section
2. Video inspections of sewer annually
3. Sensor/alarm system with flashing light and signage to alert in the event of sewer overflow
4. Operating plan changes to reflect high risk area requirements
5. Concrete sewer piping in critical area was re-lined in 2008 to make it less likely to leak



LAKE FOREST PARK WATER DISTRICT
HORIZON VIEW WELLFIELD MAP
Showing Current Infrastructure, Various Boundaries, and Topography

FIGURE 5-5

MUNDALL ENGINEERING &
P.O. Box 799
Sumas Washington 98295
Bus. (360)-855-0886
FAX (360)-855-2276
P.O. Box 50
Lytton, B.C. V0K 1Z0
Cellular (360)-319-1265
E-MAIL Dave@Mundall.com
(800)-314-0705
CONSULTING

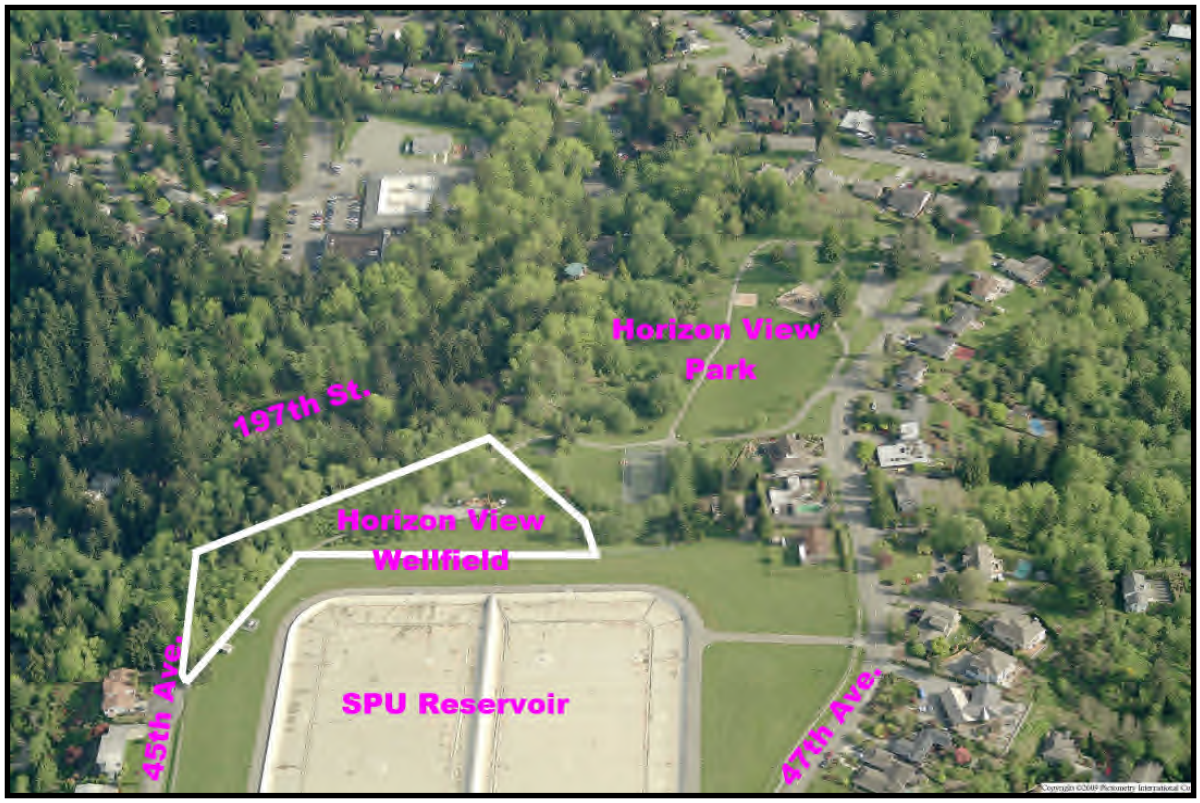
LAKE FOREST PARK WATER DISTRICT
GOOD WATER NATURALLY

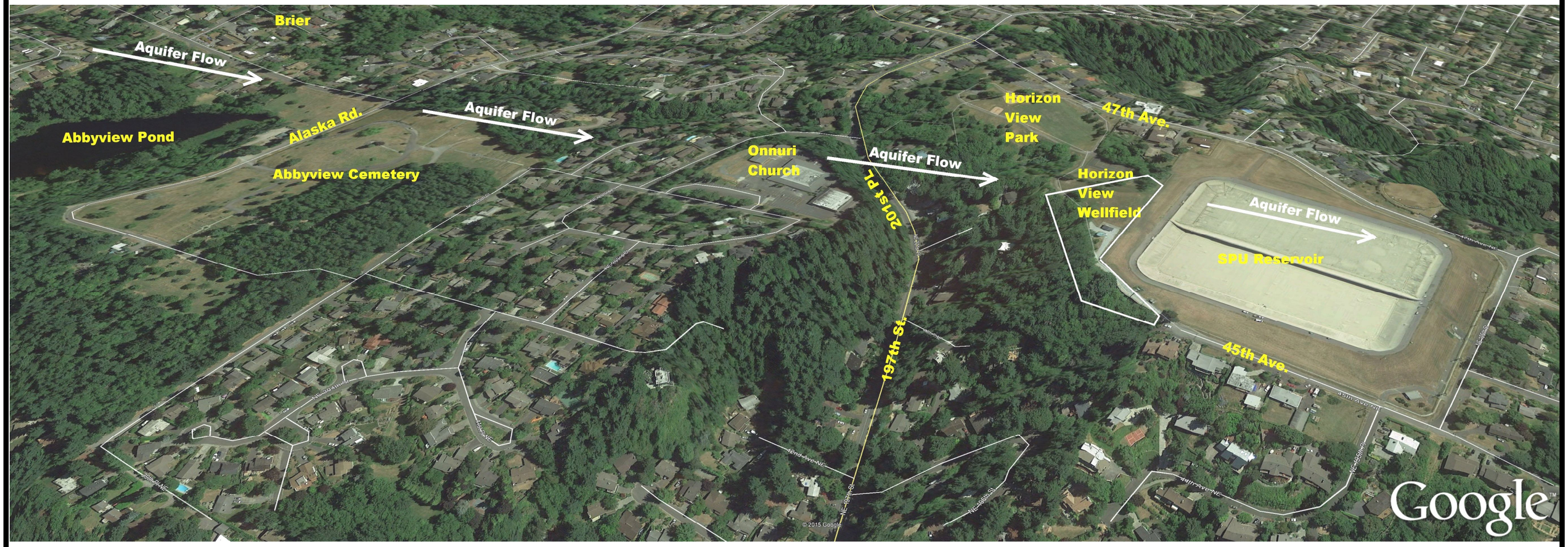
HORIZON VIEW WELLFIELD SANITARY CONTROL AREA (SCA)

The District owns about 2 acres at the Horizon View wellfield. Well placement allows a minimum 75 foot setback from adjacent properties. An exception of Sanitary zone setback was obtained on construction of the wells due to the nature of the site – drainage, well depth, and clay seal (50 feet.

Security cameras are deployed at the Horizon View site to guard against vandalism. The site is maintained by LFPWD and no chemicals are used in maintenance of the grounds.

Figure 5-6 (following page) is an oblique perspective of the Horizon View wellhead sanitary control area taken from Google Earth with annotation showing aquifer direction and wellfield boundaries. The elevated topography of Horizon View wellfield along with the geological stratum (see north-south profile of aquifer) reduces the susceptibility to contamination through the sanitary control area.





LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

MUNDALL ENGINEERING & CONSULTING

P.O. Box 799
Sumas, Washington 98295

P.O. Box 50
Lytton, B.C. V0K 1Z0

Toll Free
1-800-313-9705

Bus. (250)-455-0055
FAX (250)-455-2076

Cellular (360)-319-1285
E-Mail Don@Mundall.com

Figure 5-6 Oblique Perspective Horizon View WHPA

LFPWD_HorizonView_wellfield_EW_

PLAN FOR ITEMS LISTED IN POTENTIAL CONTAMINANT SOURCE INVENTORY (TABLE 6-1)

Several risk items and management actions (highlighted in Table 5-1with red type) have been identified through investigation in preparation of this report and through input in source protection meetings with the public. In summary, the following are considered high priority for implementation:

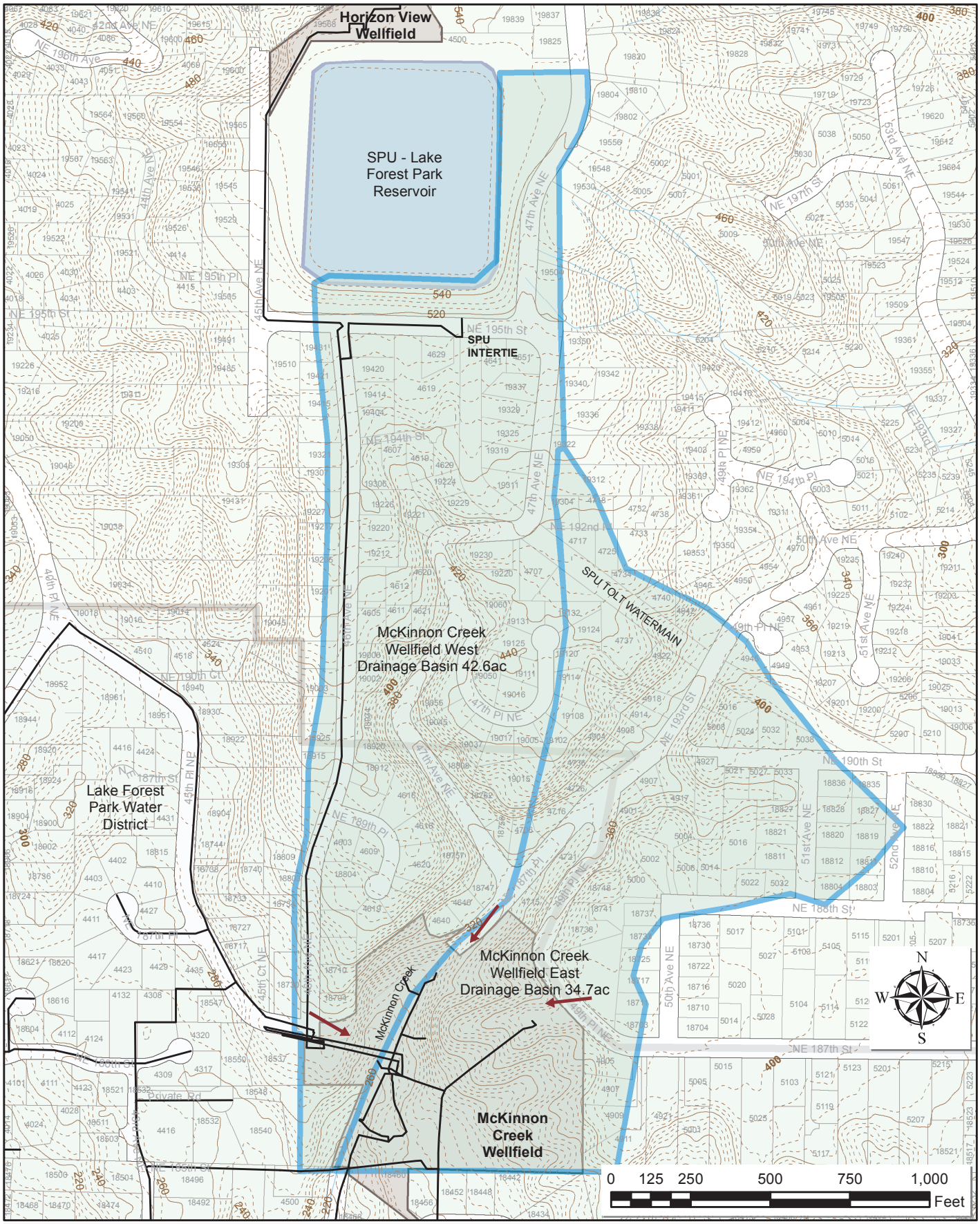
1. **Abandoned wells** in McKinnon Cr. Wellfield and near Horizon View wellfield require proper de-commissioning as soon as possible.

   Several un-used wells in the sanitary zone of McKinnon Creek wellfield have been identified and are a serious concern that requires prompt attention. In particular the following wells are of concern and two of these are highlighted red as priority. Two additional "abandoned" wells are shown on the McKinnon Creek wellfield map and listed here as we did not find a record showing they were de-commissioned in accordance with current standards:

Location/Description	Size/Depth	Other notes
8ft S. of deep well #1	6" or 8" dia. probably 200ft deep	There is a concrete cap over well casing
25ft W. of shallow well #2	Very old, looks like 6" casing depth unknown	Well is located in an open pit with steel piping in place.
25ft E-NE of deep well #3	6"? , probably 20ft deep but could be backfilled already.	Well is located in an area with significant groundwater.
15ft NE of shallow artesian well #5	Unknown dia. Unknown depth and could be backfilled already.	There is a concrete cap. Other information about abandonment is lacking.

2. **Storm water drainage runoff into McKinnon Cr. Wellfield** – Storm water drainage also presents a serious risk to the integrity of the McKinnon Creek wellfield as indicated in **Figure 5-7** (following page). 193rd Street, 46th Avenue, 47th Avenue and 187th Street convey drainage through the McKinnon Creek corridor. There is a need to highlight risk through placement of wellhead protection area signs including possible restrictions on transportation of hazardous materials in critical zones. Additional mitigating steps are recommended to reduce risk of contamination from storm water runoff. Some possibilities include:
   - Storm water filter / separators at drainage inputs
   - Repair/refurbish or enhance existing galvanized half-pipe conveyance beside utility access road
   - Periodic storm water sampling

3. **Critical Recharge Areas** (CRA) for the aquifer need to be defined. The primary CRA is believed to be in Brier. This requires additional investigation and needs to be carried out under supervision of a professional geologist.



LAKE FOREST PARK WATER DISTRICT

FIGURE 5-7

MCKINNON CREEK WELLFIELD

SURFACE WATER RUNOFF INTO MCKINNON CREEK WELLFIELD

Legend
- Drainage Basins
- 5ft Contours
- 20ft Contours
- Right of Way
- Parcels
- Water Course
- Water Body
- Wellfields
- Watermains

LAKE FOREST PARK WATER DISTRICT

GOOD WATER, NATURALLY!

MUNDALL ENGINEERING & CONSULTING

P.O. Box 799
Sumas, Washington 98295

P.O. Box 50
Lytton, B.C. V0K 1Z0

Toll Free
1-800-313-9705

Bus. (250)-455-0085
FAX (250)-455-2276

Cellular (360)-319-1285
E-Mail Dan@Mundall.com

4. **Critical Areas Ordinances** in Lake Forest Park and Brier need to be updated to reflect the sources and their critical areas. These should include the primary recharge zone as well as each Sanitary Control Area (SCA) where producing wells are located.
5. **Abbeyview Cemetery** – develop sentinel well north of the Horizon View wellfield to identify possible chemical contamination, especially formaldehyde but also Dalapon, Lindane, Nitrate, Nitrite. Dialogue with cemetery and WSDOH regarding management practices to reduce risk of aquifer contamination.
6. **Distributed pollution** risk from fertilizer/pesticide use throughout surface catchment area can be reduced by public education and by signage throughout the WHPA.
7. **NUD sewer in McKinnon Creek wellfield** – requires routine verification of sewer overflow alarm system operation and dialogue with NUD regarding agreement

VI. CONTINGENCY PLANNING

ALTERNATIVE SUPPLY

A contingency plan is needed in the event of contamination or natural disaster resulting in the temporary or permanent loss of one or all of the wells. The contingency plan identifies the amount of water required to sustain the community, alternative sources of supply interties with other water systems, purchase, and delivery of water, and future sources of drinking water.

Contingency Planning Facts:

- The District has enough storage (515,000 gallons total) to last more than one day with adequate pressure, at average usage (260,000 gallons), without water restrictions in place.
- The wells in two wellfields draw from a similar aquifer but the presence of several clay lenses in the glaciated area would likely keep a single contamination event from making all the wells unusable.
- Other disasters, such as a prolonged power outage are unlikely to affect both wellfields so the District could rely on the other wellfield. Additionally, the District has a standby generator that is capable of operating either wellfield.
- The District has an existing intertie with Seattle Public Utilities at 195th Street which is presently capable of 1250 gpm – and will be increased to 2,000gpm in the near future.
- There is also an intertie with NUD at the McKinnon Creek Wellfield. This intertie has been used on an emergency basis to augment the District's water supply. In the event that groundwater contamination would reduce the ability of the District to provide sufficient quantity or quality of water to their customers, the interties would potentially allow the utility to purchase water on an emergency basis.

EMERGENCY PREPAREDNESS - SPILLS

Fact: *Soils in areas of the McKinnon Creek WHPA are relatively permeable and spilled liquids could be absorbed quickly.*

Mitigating Actions:

- King County emergency response has one of the best HAZ-MAT teams in the state and they are located nearby in Bellevue, 15 miles south of the District. If they could not handle the spill they would contact the Washington State DOE. King County Health Department would also be contacted. A hazardous spill response notice (**Appendix 5-I**) has been sent to local emergency responders and local emergency planning agencies to inform them of the sensitive nature of the WHPA. The agencies can use this information to evaluate whether changes in hazardous spill response measures are needed to protect the water supply.
- The District maintains fuel absorption pads at the McKinnon Creek wellfield that could be used to mitigate a fuel/oil spills.
- Fuel absorption pads will be available at the Horizon View wellfield in the event of standby generator use.

CONCLUDING REMARKS

With the continued dedication of the water system operators and efforts to educate the public, the District will have a clean, reliable water supply far into the future. Particular attention is recommended on the action items identified in **Table 5-1** to ensure that potential contaminants are managed appropriately.

Please refer to **Appendix 5-J** for a Record of Notifications relating to the Source Protection Program. A record of public meetings, and documents relating to the community advisory committee can be found in **Appendix 5-K**. System v*ulnerability analysis* can be found in Part Six of this document. Record of completion of a Security Vulnerability Self-Assessment (federal EPA) can be found in **Appendix 5-L**.

PART SIX - OPERATION AND MAINTENANCE PROGRAM

The following sections outline the Districts program for operating and maintaining the system in accordance with WAC 246-290-100.

I. WATER SYSTEM MANAGEMENT AND PERSONNEL

The District operates under the direction of three elected Commissioners who retain a General Manager. Alan Kerley is the present General Manager and he is also responsible for field operations and water quality with the assistance of several part time staff. In addition to regular staff, the District also hires temporary summer help. Figure 6-1 is an organizational chart for the District.

(A) ORGANIZATIONAL CHART

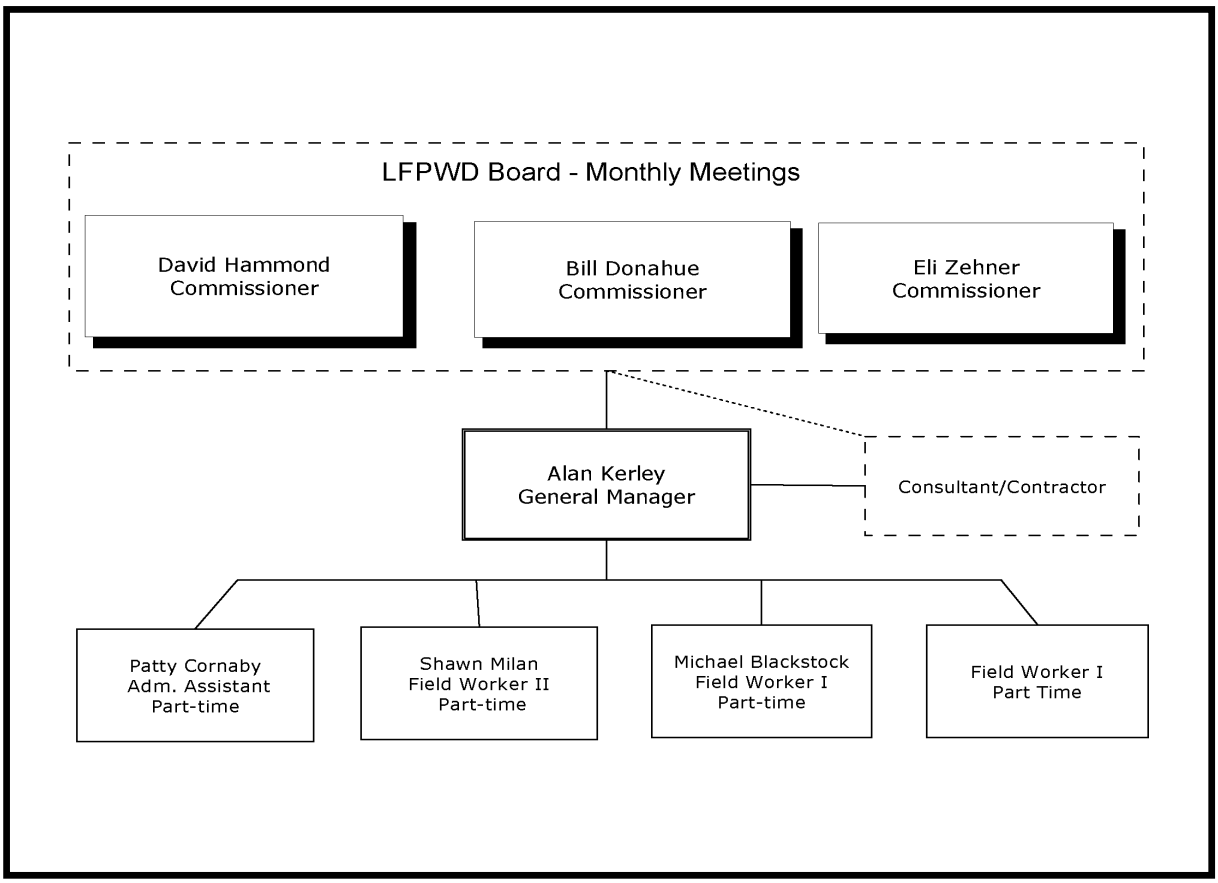


Figure 6-1 Organizational Chart

(B) PERSONNEL RESPONSIBILITIES

General Manager:

Purpose of Position: The General Manager is responsible for the effective operation of the Lake Forest Park Water District and for advising and making recommendations to the Board of Commissioners with respect to activities and policies. This is a salaried and overtime exempt position. This is an "at will" position that serves at the discretion of the District's Board of Commissioners.

Essential Job Functions:
The General Manager, under the supervision and direction of the Board of Commissioners, is responsible for all elements of District operations.

The General Manager is responsible for and has commensurate authority to accomplish the duties set forth below. The General Manager may delegate portions of his or her responsibilities and commensurate authority consistent with sound operating practices and authorized policies and procedures, however, the General Manager may not delegate nor relinquish any portion of his or her accountability for results. The General Manager is responsible for the following:

1. Formulate and recommend basic policies and programs, including financial and budgeting programs, for approval of the Board of Commissioners. Specifically, the General Manager shall develop an annual budget, a periodic update to the District's comprehensive plan and policy recommendations as needed. The General Manager's compensation shall be established by the Board of Commissioners. The General Manager shall propose to the Board of Commissioners, with every annual budget, total staff compensation and benefits for the upcoming year, but the General Manager shall have the authority to determine specific levels and changes to staff compensation.
2. Work directly with legal counsel and consulting engineers as appointed by the Board of Commissioners in order to cause the District to conform to applicable laws and engineering standards; and monitor and evaluate legislative issues and actions that will or could impact the District.
3. Develop and implement procedures to carry out the policies and functions of the District.
4. Supervise field and office staff; ensure that the District is staffed with competent people; ensure that staff members are delegated proper authority and that appropriate limitations of their authority are defined and understood with respect to duties, policies and expenditures.

5. Hire, promote, discipline and terminate staff; obtain Board of Commissioner approval for creating or eliminating staff positions.
6. Directs the performance of all District services.
7. Presents for approval to the Board of Commissioners all proposed contracts, agreements, and commitments of the District except those that may be specifically delegated to the General Manager or staff by resolution of the Board of Commissioners.
8. Oversees the authorized and proper expenditure of District funds, and assures that all funds, physical assets, and other property of the District are appropriately safeguarded and administered.
9. Executes such other general responsibilities as may be assigned by the Board of Commissioners.
10. Exhibits a high level of professionalism and integrity in all personal and business activities.

Education: 14 years or applicable experience

Licensing/Certification: Water Distribution Manager Class 2, Cross Connection Control Specialist, Water Distribution Specialist, Flagging Card

Knowledge, Skills, Abilities and Experience: Minimum 6 years experience in the operation and management of water system facilities including water supply and water treatment; strong leadership skills in order to build and maintain effective working relationships with staff, the Board of Commissioners and customers; excellent collaboration skills. Experience and extensive knowledge of the structure and operation of federal, state, and local governments, including experience in legislative, administrative agency rule-making procedures, and establishment of rates; must be a person of high ethics and integrity with good writing and presentation abilities; must be able to present material publicly to small and large groups of professionals and/or non-professionals that is understandable to both the technical and non-technical person.

Physical Requirements: Must be able to operate licensed vehicles on public roads; traverse steep and difficult terrain; climb and descend ladders and steps; moderate lifting, must be proficient with power and hand tools etc.

Working Conditions: Work activities consist of office and field conditions with potential exposure to inclement weather.

Miscellaneous Requirements: Ability to respond to District emergencies and after hour calls 24 hours a day unless otherwise delegated to District staff.

Administrative Assistant:

Duties are variable depending on staff resources. Admin. staff is expected to answer all customer queries and complaints and verify action taken.

Minimum Qualifications: Knowledge of Microsoft Office, good customer service skills

Skill in the following areas: Good computer skills, knowledge of database management, phone/email correspondence, effective writing skills, Quickbooks experience desirable

Field Worker II:

Duties are primarily performed in the field and may include exposure to inclement weather for extended periods of time and require the routine lifting of heavy objects up to 50 lbs. The work generally consists of routine maintenance of the water distribution system and District facilities. This position is responsible for carrying out work assigned by the General Manager and communicates directly to the General Manager on any field related issues.

Minimum Qualifications:

- Valid Washington State Driver's License
- Ability to obtain Flagger and CPR Certifications within first year of employment
- Able to lift 50 lbs routinely
- High School Diploma or GED

Field Worker II - Skill in the following areas:

- Ability to use power hand tools safely
- Reading blueprints, as-builts and maps
- Customer service and communication
- Operating construction equipment such as backhoes, vacuum trailers, jackhammers, plate and soil compactors, cut-off saws, etc.
- Safely towing a tandem axle trailer
- Job site set up
- Miscellaneous Requirements: Ability to respond to District emergencies and after hour calls

Field Worker I:

Duties are primarily performed in the field and may include exposure to inclement weather for extended periods of time and require the routine lifting of heavy objects up to 50 lbs. The work generally consists of routine maintenance of the water distribution system and District facilities.

Minimum Qualifications:
Valid Washington State Driver's License
Ability to obtain Flagger and CPR Certifications within first year of employment
Able to lift 50 lbs routinely
High School Diploma or GED

Field Worker I is expected to have skill in the following areas:

- Ability to use power hand tools safely
- Reading blueprints, as-builts and maps
- Customer service and communication
- Operating construction equipment such as backhoes, vacuum trailers, jackhammers, plate and soil compactors, cut-off saws, etc.
- Safely towing a tandem axle trailer
- Job site set up
- Miscellaneous Requirements: Ability to respond to District emergencies and after hour calls

Summer Help:

Duties are primarily performed in the field and may include exposure to inclement weather for extended periods of time and require the routine lifting of heavy objects up to 50 lbs. The work generally consists of assisting with routine maintenance of the water distribution system and District facilities.

(C) STAFF CERTIFICATION AND PROFESSIONAL GROWTH

The District places a high emphasis on certification and professional growth because these have a direct bearing on safety, knowledge and ability, and because it is required by Washington State law (WAC 246-292). Certification and training of personnel is doubly important considering the small staff size of the District.

Table 6-1 summarizes current certifications held by District staff and the renewal intervals required for each.

Name	*Position*	*Certification*
Alan Kerley	*General Manager*	WDM2, WDS, CCS, Flagging, FEMA,
Mike Blackstock	*Utility Worker*	
Shawn Milan	*Utility Worker*	Flagging

Acronym **Description**	**Duration/Commitment**
WDM – Water Distribution Manager	5 years
WDS – Water Distriubution Specialist	3 years
WTP – Water Treatment Plant Operator	3 years
CCS – Cross Connection Control Specialist	2 years
CPR – Cardio Pulmonary Resuscitation	3 years
BAT – Backflow Assembly Tester	3 years
Flagging – Traffic Control/Flagger	

Table 6-1 District Staff Certifications

It is the District's policy to encourage participation in workshops, seminars and other educational programs to improve job skills, maintain safety compliance and Washington State certification for Water Works Operators. Safety compliance certification classes such as Confined Space Training, C.P.R., Flagging, etc. as approved by the General Manager for full and non-temporary part time employees will be paid for by the District. The State requires the District to employ at least one employee with a Water Distribution Manager 2 and Cross Connection Control Specialist Certificate of Competency. Certification exams for those certificates will be paid for by the District if the exam is passed. Participation in programs requiring time off from work and payment of tuition or per diem expenses require prior approval from the Board or General Manager.

Continuing education classes offered by accredited schools or colleges taken on employee time will be considered for tuition reimbursement if they are determined, in advance, by the Board to benefit the District. The employee requesting reimbursement must produce proof of successful completion and the class must be determined to be relevant to the position.

II. NORMAL SYSTEM OPERATION AND MAINTENANCE

This section outlines the tasks and staffing involved in normal operation activities in the District. The following pages describe principal operation and maintenance tasks in greater detail. Specific procedures are listed in **Appendix 6-A** for reference:

SYSTEM MONITORING

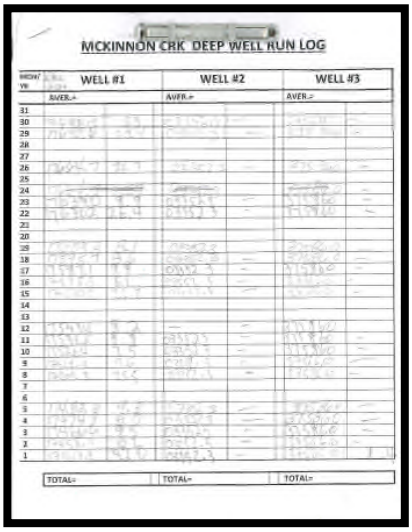
Wellfield Inspection and Monitoring

The District has two well- fields, *McKinnon Creek* and *Horizon View*, which need to be inspected on a daily basis for public safety, vandalism, tampering and damage from the elements or environment. Inspection forms are found at the respective pump/control houses at the well-field and are also available in the forms section of this manual.

Lake Forest Park Water District has video surveillance at both well-fields to prevent and to aid in the prosecution of vandalism, terrorism and tampering. Timely reporting of any such incident is critical for data retrieval as these devices have limited storage capacity. Video surveillance is accessible through the internet with secure password access.

Manual Logs - Master Meter, Transfer Pumps

Master meter reads are used to calculate daily, monthly and annual water production numbers. The District has a master meter at the McKinnon Creek wellfield as well as mastermeters in the Horizon View system. The readout is set up to show thousands of gallons and we record the amount each day. We record in the morning so that we have consistent time readings. Each month a new log is started and the finished monthly report is filed.


MCKINNON CRK DEEP WELL RUN LOG

	WELL #1	WELL #2	WELL #3
	AVER.->	AVER.->	AVER.->
31			
30			
29			
28			
27			
26			
25			
24			
23			
22			
21			
20			
19			
18			
17			
16			
15			
14			
13			
12			
11			
10			
9			
8			
7			
6			
5			
4			
3			
2			
1			
	TOTAL->	TOTAL->	TOTAL->

Transfer pump logs are kept each day and we record the hours each pump operates. Each month a new log is started and the finished monthly report is filed in the top drawer of the light colored filing cabinet.

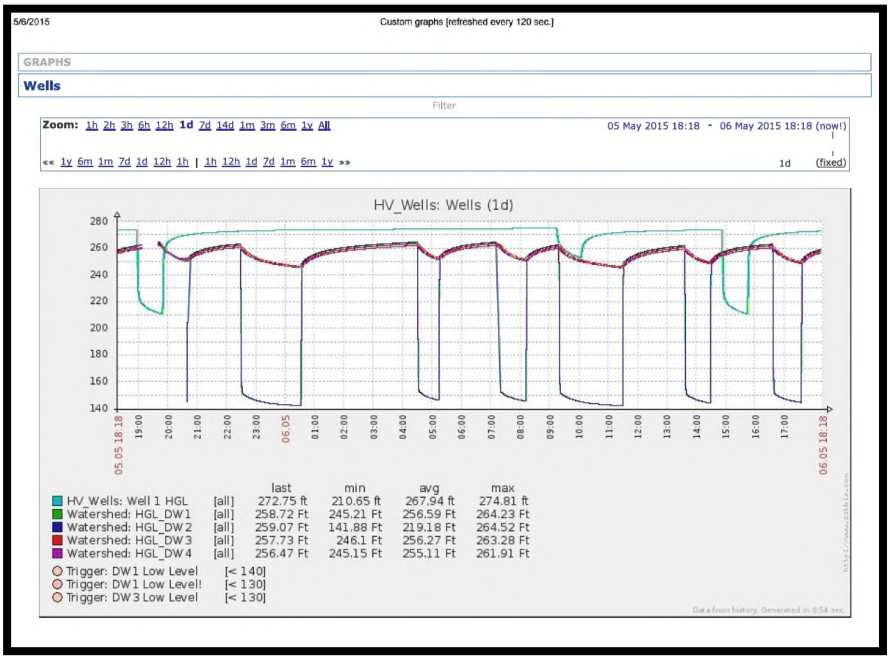
Well logs are maintained for three deep wells at the McKinnon Creek Well Field and two deep wells at the Horizon View Well Field showing the hours that each one operates each day. Again this is a good way to

detect any problems that may be happening. Each month a new log is started and the finished monthly report is filed in the top drawer of the light colored filing cabinet.

All of the above forms are found at the respective pump/ control houses at the well-field and blank forms are also available in the forms section of this manual.

Telemetry

The District also has a telemetry or SCADA (Supervisory Control and Data Acquisition) system in place which provides additional and supplemental data, system alarm notifications and provides data retrieval of a defined time parameter. The SCADA system is hosted locally on a server in the District office and is equipped with backup power capability. Operating system is Linux. Telemetry data are logged using open source software "Zabbix".



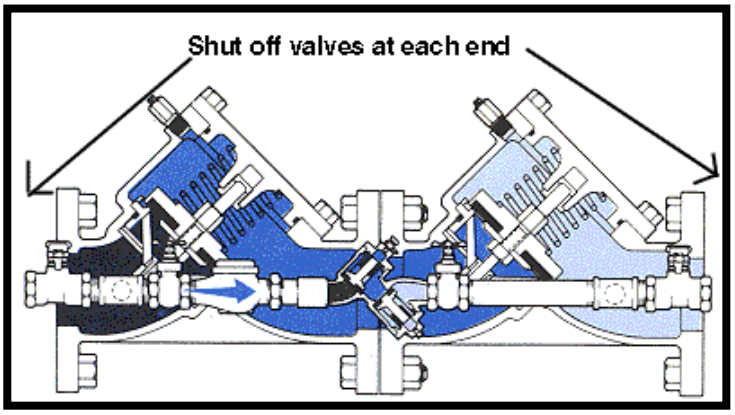
The telemetry system will be monitored for irregular pump and tank drawdown on a daily basis under normal conditions.

Washington State Dept. of Health Water Quality Monitoring

Each year the DOH sends out a Water Quality Monitoring Report. Included in the report will be the Monthly Coliform Sampling Schedule as well as any other type of water monitoring requirements established by DOH. These samples must be taken during the scheduled month on the form. Sample bottles and information on how to take the samples are available from the lab we currently use, Edge Analytical (1-800-725-1212). Additional information is also available on the DOH website.

Cross Connection Control

The District adopted a Cross Connection Control Program in accordance with WAC 246-290-490. The District's Cross Connection Control Specialist is Alan Kerley, and the program was last evaluated in 2012. The District currently has 3 Table 9 cross connection hazards within its service area. All three have appropriate backflow devices installed on their system. The District continually monitors for new installations such as irrigation systems and new construction back flow requirements.



Annual test reports are required from our customers that have backflow devices in their system and logs are kept showing when reminder letters were sent to customers and also when the test was returned. We have our own Backflow Test Form and customer reminder letter. This letter has a due date for the report to be submitted to us. If we do not receive a response, a second and third letter will follow. Each letter spells out what may happen if we do not receive a test report. The three year compliance percentage from our customers is 94.8%. Sample copies of letters are contained in **Appendix 6-B**

When the letters are sent to the customer it includes our website link to a list of approved Backflow Assembly Testers and our blank report form. The Testers list is based upon letters from the various companies that do this kind of work and has provided us with the following:

1. A certificate of Insurance
2. Certificates showing the Tester has the proper license
3. Calibration of the testing instruments

Backup Power System Operation

The main component of our back up power system is an 80kw Onan/Cummins diesel generator. This generator is trailer mounted and can supply power to operate either the McKinnon Creek or Horizon View wells. Careful monitoring and routine maintenance will ensure that the District's back up power source is available for use at any time. Generalized maintenance tasks for the backup generator are listed here:

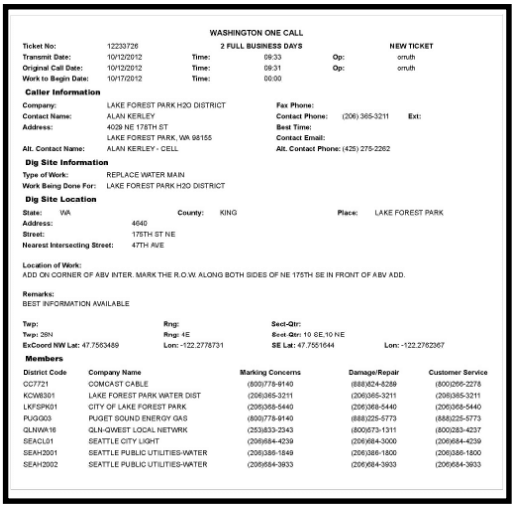
- The 120 volt system that supplies the block heater should be monitored daily as the power feed from Well 3 has a GFI.
- Oil levels are checked routinely and prior to starting the generator.
- The generator is normally started and run a minimum of ten minutes every month.
- Any variations in condition or output of the generator need to be reported to the General Manager.
- Run logs are normally filled out whenever the generator is used.
- Cycling and conditioning of the diesel fuel. Fill all diesel fueled District equipment from the diesel storage tank inside the generator trailer. Replenish the tank with fresh and add fuel conditioner periodically.
- An annual test is needed to ensure the proper function of the system. This test will normally occur no later in the year than October and shall consist of the generator being brought under load and providing power to McKinnon wells 1 and 3 and transfer pump 2.

As part of the routine monthly maintenance the following items will normally be inspected:

- The cable from the generator to the pump house and the connections
- The light sources stored in the generator trailer are working
- The auxiliary battery system for running the diesel storage tank pump is working.

Utility Locates

The District receives locate tickets from Utilities Underground Location Center (www.washington811.com, www.callbeforeyoudig.org. These tickets contain valuable information about the activities of other utilities, contractors and property owners. Monitor these tickets for any conflict with or infringement of District infrastructure.



WASHINGTON ONE CALL

Ticket No:	12230726	2 FULL BUSINESS DAYS			NEW TICKET
Transmit Date:	10/12/2012	Time:	09:33	Op:	omuh
Original Call Date:	10/12/2012	Time:	09:31	Op:	omuh
Work to Begin Date:	10/17/2012	Time:	00:00		

Caller Information

Company:	LAKE FOREST PARK H2O DISTRICT	Fax Phone:	
Contact Name:	ALAN KERLEY	Contact Phone:	(206) 365-3211 Ext:
Address:	4029 NE 178TH ST	Best Time:	
	LAKE FOREST PARK, WA 98155	Contact Email:	
Alt. Contact Name:	ALAN KERLEY - CELL	Alt. Contact Phone:	(425) 275-2262

Dig Site Information

Type of Work: REPLACE WATER MAIN
Work Being Done For: LAKE FOREST PARK H2O DISTRICT

Dig Site Location

State: WA County: KING Place: LAKE FOREST PARK
Address: 4640
Street: 175TH ST NE
Nearest Intersecting Street: 47TH AVE

Location of Work:
ADD ON CORNER OF ABV INTER. MARK THE R.O.W. ALONG BOTH SIDES OF NE 175TH SE IN FRONT OF ABV ADD.

Remarks:
BEST INFORMATION AVAILABLE

Twp: Rng: Sect-Qtr:
Twp: 26N Rng: 4E Sect-Qtr: 10 SE,10 NE
ExCoord NW Lat: 47.7563489 Lon: -122.2778731 SE Lat: 47.7551644 Lon: -122.2762367

Members

District Code	Company Name	Marking Concerns	Damage/Repair	Customer Service
CC7721	COMCAST CABLE	(800)778-9140	(888)624-8289	(800)266-2278
KCWB301	LAKE FOREST PARK WATER DIST	(206)365-3211	(206)365-3211	(206)365-3211
LKFSPK01	CITY OF LAKE FOREST PARK	(206)368-5440	(206)368-5440	(206)368-5440
PUGG03	PUGET SOUND ENERGY GAS	(800)778-9140	(888)225-5773	(888)225-5773
QLNWA16	QLN-QWEST LOCAL NETWRK	(253)833-2343	(800)573-1311	(800)283-4237
SEACL01	SEATTLE CITY LIGHT	(206)684-4239	(206)684-3000	(206)684-4239
SEAH2001	SEATTLE PUBLIC UTILITIES-WATER	(206)386-1849	(206)386-1800	(206)386-1800
SEAH2002	SEATTLE PUBLIC UTILITIES-WATER	(206)684-3933	(206)684-3933	(206)684-3933

After completion of the locate request remember to initial and date the ticket. Tickets are kept in the Locate File, by year, in the second drawer of the light colored filing cabinet.

Specifics such as type of work, location and contact information will be provided on these tickets. UULC's phone number is 1-800-424-5555.

Water Main Flushing

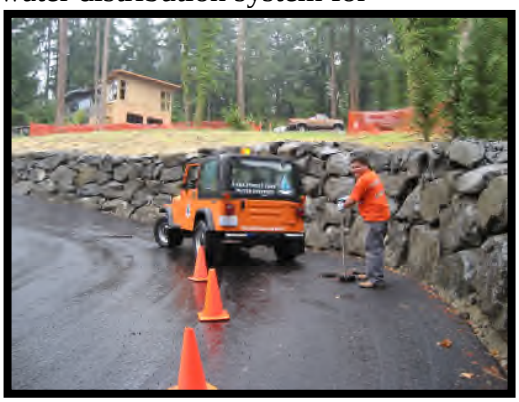
Water mains are flushed on schedule each year. Limited main flushing is done in the event of a questionable water sample or customer complaint of poor water quality. Pipe flushing is done to remove sediments that may accumulate and to freshen dead end lines. The City of LFP Public Works Dept. needs is notified and provided with an approximate schedule prior to any water main flushing.

Valves operated during water main flushing are noted and considered as operated in conjunction with the District's valve exercise/ maintenance program.

An updated system network map is normally used to identify factors like pressure reducing valves, normally closed valves and areas where flushing into the city's storm system may cause problems. Indicate the water mains that have been flushed and the valves that have been exercised on this map and keep it for future reference.

Valve Exercise and Maintenance Program

System valves are used primarily to isolate an area of the water distribution system for emergency repairs while keeping the rest of the system in service. To keep these valves accessible, the District institutes an annual valve exercise/ maintenance program that consists of the following:



- Valves are verified against the system network map for accuracy and any changes or inaccuracies are reported.
- Normally closed valves are not operated. Normally closed valve lids will be painted red and have a length of pipe inside the valve box to prevent operation.
- Valves are operated to the fully closed position and returned to the fully open position and then backed off one ¼ turn.
- Valve box lid seats will be cleaned to ensure proper seating of the valve lid.
- Inaccessible/ inoperable/ leaking valves shall be reported and action taken to correct the problem.
- The District will work with the City of LFP to ensure that valve box risers are installed during asphalt overlays.
- Valves that have been exercised shall be indicated on the system network map for water main flushing and valve operation for the current year.

Fire Hydrant Operation and Maintenance

The District operates fire hydrants annually, using a service code format. These service codes are used to track maintenance history and to generate deficiency lists which are then completed after the Fire Hydrant Maintenance Route is finished.

Fire hydrants that are found to be inoperable are immediately reported to Northshore Fire Department, tagged/bagged out of service and repaired as soon as possible and called back in service.

New fire hydrants are added into the route in the appropriate sequence and any fire hydrant information that is inaccurate is corrected.

Meter Reading

The District reads meters and bills every two months. A Meter Reading Schedule is posted at the front desk and in the General Manager's office. Our meters are manual read and we also enter the reads into our billing system manually. It takes around 30-35 labor hours to read and double check the meter reads, 6 labor hours to enter the reads into the billing system and around 12 labor hours to produce, stuff, stamp, seal and mail the billing.

While reading meters field staff will check for stuck meters and leaks, leave door tags if the meter is inaccessible and note any other deficiency in regards to the meter or meter box.

Several weeks prior to reading, field staff will maintain the routes by marking hard to find meters and clearing out any vegetation that may hinder reading the meters.

During the October meter reading cycle, field staff will note any meter box in need of winterizing. Upon completion of the reading cycle, field staff will then winterize meter boxes with clean sawdust up to the level of the meter lens.

Service meters are replaced by age. The District tests individual meters in-house as requested by customers where there are questions on the integrity of a particular meter. Meter take-outs are periodically tested in-house against new meters to confirm the adequacy of replacement scheduling.

Vegetation Control

The District maintains approximately 15 acres of watershed and facilities. The Districts Vegetation Control Program is needed to keep District infrastructure protected and accessible. Here are some of the elements of the Districts Vegetation Control Program.

- Leaf removal from pathways, roadways and parking lots
- English ivy control around trees in the watershed
- Weed eating around fire hydrants, PRV stations, shallow wells, etc.
- Lawn mowing at District office and watersheds

Special care is taken in the watershed areas to ensure that no chemicals are used or applied and that no fueling of equipment occurs in the area.

The McKinnon Creek Watershed is heavily wooded and it is important that the health of trees that could risk infrastructure be monitored. Monitoring for loose limbs or "widow makers" is also critical for safety and infrastructure.

Pressure Reducing Valve Maintenance

Entering a PRV vault requires a Confined Space Entry Permit and attendant. Please refer to the Safety Manual or the Confined Space Entry Program Manual for details on Confined Space Entry.

Pressure reducing valve stations are normally inspected and checked for the appropriate pressure settings annually or if zone pressure varies from historic normal operating pressure.

Manufacturer recommendation is for tear down and rebuild of main valves every 5 years. The District has several newer PRV stations that will need to be serviced at the 5 year recommendation and then inspected for wear and build up. A service schedule recommendation by the District is normally made at that point in time.

Pressure reducing valve maintenance is done using a service code format. These service codes are used to track maintenance history and are maintained in a database on Raid 2.

Periodic Reservoir Maintenance and Cleaning

The District currently has four reservoirs (tanks) in service. Tanks are normally taken out of service every five years for cleaning and inspection. Current status is shown here:

- The High Zone standpipe at McKinnon Creek was retrofitted in 2010 and cleaned in 2015.
- The Low zone Standby tank at McKinnon Creek was improved and returned to active service in 2012.
- The Low Zone tank at McKinnon Creek was cleaned and inspected in 2012.
- The 50,000 gal reservoir at Horizon View was placed in service in 2013.

Here are a few things to remember about tank maintenance and cleaning:

- Man-way gaskets can have a long lead time so have a spare in stock.
- Tank levels are normally drawn down as far as possible before being taken out of service and drained.
- Monitor the outfall from the tank drain for the need of erosion control measures.
- Open all hatches and man ways when the tank is empty for air flow.
- Inspect the condition of all nuts, bolts and gaskets upon removal.
- A tank is a confined space. Follow confined space procedures before entering.
- Protect all paint surfaces while pressure washing the interior walls and floor.
- Visually inspect for any deficiencies such as pitting, rust trails or paint bubbling.

All tanks need to be disinfected and purity tested before being returned to service. The preferred method of disinfection is to spray all interior tank surfaces with a 200 mg/l chlorine solution with a least one half hour of contact time before filling.

TASK AND LEVEL OF EFFORT SUMMARY

Table 6-2 summarizes the frequency and level of effort that has been observed for normal system operation and maintenance. Tasks are divided between administrative, operations and maintenance, including scheduled and unscheduled maintenance activities such as leak repair. Hours are estimated for each task and interval.

Staffing - Annual Projected Level of Effort 2015

Table 6-2

Hours Staffing Time

Administration/Management/Engineering Activity	Intervals per year	District Manager	Maint.	Maint. FW2	Maint. FW1	Summer Help	Temp	I.T Help	Engineering	Event Total	Annual Man-Hours	Avg. Week Man-Hours
		1.0 FTE	0.5 FTE	1.0 PTE	2.0 - PTE	CONTRAC	TEMP	CONTRAC	CONTRACT			
Monthly Reporting and logging of System Performance	12	3	1			5			2	11	132	2.5
Payroll / Accounts Payable / Accounts Receivable	52	2	3			4				9	468	9.0
Supervision & Scheduling	52	3								3	156	3.0
Procure Parts/Supplies/Services	52	1	0.5							1.5	78	1.5
Contract Management/Related Correspondence	6	4	1							5	30	0.6
Cross Connnection control	24	2	2									
Meter Reading & customer billing processing/mailing	6	10	3	16	10	5				44	264	5.1
Misc. Administrative	52	4	4			2				10	520	10.0
Budgeting	2	10				10				20	40	0.8
Preparation of Reports	12	2	4						2	8	96	1.8
Surveys and questionnaires	12	2	0.5							2.5	30	0.6
Employee Training	52	1								1	52	1.0
Employee Evaluation	1	24								24	24	0.5
Board Meetings	16	4	4							8	128	2.5
GIS/Mapping Maintenance	15							2		2	30	0.6
Preparation for leak repair and new services	11	3								3	33	0.6
Administration of Capital Improvement Plan	12	1	2						12	15	180	3.5
Water Quality and Testing	12	1						1.5	1	3.5	42	0.8
Public Relations	52	2.5	1							3.5	182	3.5
Conferences & Workshops	1	16	16	8						40	40	0.8
Customer Interaction	52	3	3			1				7	364	7.0
Development and Implementation of Programs	12	2	2							4	48	0.9
Information System Administration	52	1						2	1	4	208	4.0
Routine Correspondence and Filing	52	2	2			1				5	260	5.0
Annual Multiplied Subtotal		1435.0	968.0	104.0	60.0	526.0		152.0	256.0	234.0	3405.0	65.5
Week Avg. Multiplied Subtotal		27.6	18.6	2.0	1.2	10.1		2.9	4.9	4.5	65.5	
Day Avg. Multiplied Subtotal (7 day week)		3.93	2.65	0.28	0.16	1.44		0.42	0.70	0.64		
Working Day Average Total (Less Weekend/Holiday/Sick)		6.1	4.1	0.4	0.3	2.2		0.6	1.1	1.0		
Maintenance Activity												
Tank Cleaning	0.2	10		10						20	4	0.1
Leak Repair	9	8		5	5					18	162	3.1
Maintain Hydrants,	110			0.5	0.5					1	110	2.1
Maintain Meter Routes	3			8	8					16	48	0.9
Landscaping/Mowing	20			3	3		4.5			10.5	210	4.0
Annual Line Flushing	1	20		40	40					100	100	1.9
PRV Maintenance	4	16		16				25		57	228	4.4
Shallow Wells - Routine maintenance	12			0.25	0.25					0.5	6	0.1
Vehicle Maintenance/Repairs	26	0.25			1					1.25	32.5	0.6
Building and Facilities maintenance	26	1		5	5					11	286	5.5
Annual Multiplied Subtotal		190.5		423.0	383.0		90.0	100.0		235.25	1186.5	22.8
Week Avg. Multiplied Subtotal		3.7		8.1	7.4		1.7	1.9		4.5	22.8	
Day Avg. Multiplied Subtotal (7 day week)		0.52		1.16	1.05		0.25	0.27				
Working Day Average Total (Less Weekend/Holiday/Sick)		0.8		1.8	1.6		0.4	0.4				
Operations Activity												
Daily well drawdown / Operating logs	260			0.75	0.75					1.5	390	7.5
Locates	88	0.25		0.75						1	88	1.7
Sampling	104	0.25		2.5	2.5					5.25	546	10.5
Training & Safety	20	0.75		0.75	0.75					2.25	45	0.9
Drive time	260	1		0.5	0.5					2	520	10.0
Annual Multiplied Subtotal		323.0		666.0	600.0			50.0		1639	1589	30.6
Week Avg. Multiplied Subtotal		6.2		12.8	11.5			1.0		31.5	30.6	
Day Avg. Multiplied Subtotal (7 day week)		0.88		1.82	1.64			0.14		4.49		
Working Day Average Total (Less Weekend/Holiday/Sick)		1.4		2.8	2.6			0.2		7.0		
Totals		Hours										
Annual Multiplied Total		1948.5	968.0	1193.0	1043.0	526.0	90.0	302.0	256.0	6326.5	6180.5	118.9
Week Avg. Multiplied Total		37.5	18.6	22.9	20.1	10.1	1.7	5.8	4.9	121.7	118.9	
Day Avg. Multiplied Total (7 day week)		5.3	2.7	3.3	2.9	1.4	0.2	0.8	0.70	17.33		
Working Day Average Total (Less Weekend/Holiday/Sick)		8.3	4.1	5.1	4.5	2.2	0.4	1.3	1.1	27.0		

file: Raid-2:\System Plan\O&M Schedule.xls

Table 6-2 System Operation Task and Level of Effort Summary

OUTSIDE SUPPORT ENTITIES

In addition to regular staff, the District occasionally relies on contractual assistance through mutual aid agreements with NCWD and NUD. Separate contractual assistance is provided through several other private entities that provide specialized maintenance and repair support. **Table 6-3** summarizes outside support by infrastructure, task and contract entity for current vendors. Outside contractual arrangements are either made through the Small Works Roster or by direct selection for small jobs.

Infrastructure	*TASK*	*Contract Entities*	*SPECIALIZED SERVICES/EQUIPMENT REQUIRED*
PRV's	Inspection, maintenance and repairs	NCWD NUD Mundall Engineering	Confined space support as needed
Watermains	Leak repairs	NCWD NUD	Excavator, compactor, Dump and Support Trucks
Reservoirs	Cleaning, inspection	NCWD NUD	Confined Space entry
Pumps/Electrical ***Pumps/Mechanical***	Electrical work Pull well pumps/repair/TV/ Video inspection of wells	Hill Electric Aqua Flow, Puyallup	State Lic. Electrician Specialized mechanical services, lifter, video inspection
Computer system/network	Hardware/software support/upgrade	Mundall Technical Services	Network administration/system specific background
Billing Software	Billing Software support	Robert Heald SAA (System & Application Associates, Inc.)	Programmer/creator of billing software

Table 6-3 Outside Support

\\Raid\raid-2\System Plan Work\W83Plan.DOC

III. EMERGENCY RESPONSE AND SAFETY

This section outlines District policy for responding to emergencies and for ensuring safety in system operation.

CONTACT INFORMATION AND GENERAL PROCEDURES

In the event of an emergency, District staff are available 24 hours at the regular District phone number. After hours callers are given the "Emergency" option on the District's PBX in the order listed below. Emergency calls are routed to the following staff (listed below). The PBX system will continue calling until confirmation is received by at least one recipient:

1. General Manager (or current operator) cell phone and system VOIP phones simultaneously
2. Mundall Engineering, cell phones

The District has mutual aid agreements with both NUD and NCWD to provide staffing and equipment support in the event of an emergency.

In the event of a system emergency or water quality emergency District staff has the following procedures for notification:

PROCEDURES FOR NOTIFYING SYSTEM CUSTOMERS OF POTENTIAL WATER SHORTAGE/CONTAMINATION

Who is responsible	***The District General Manager is ultimately responsible for making the decision to notify customers regarding a potential water shortage/contamination and the need for water use restrictions. The District Manager will consult with field staff to make the decision. Once the decision is made procedures for notification will be initiated.***
Procedures:	In the event of emergency water chlorinating, the District maintains a list of customers who wish to be notified. • General Manager organizes staff to develop the message to be delivered to the customers. • General Manager consults with state drinking water staff regarding the problem. • General Manager with assistance from staff prepares door hangers, signs and radio message. • Water system operator continues to investigate problem and make repairs as necessary. • General Manager calls DOH Northwest Regional Office Manager Robert James within 24 hours at (253) 395-6768. • The water shortage/contamination notification will be distributed by: 1. Field staff placing “water shortage notices” on doors and along travel routes. 2. Field staff calling Lake Forest Park Town Center and Lake Forest Park Elementary (206) 361-4200 3. Staff will place signs on main travel routes into the community. 4. General Manager contacts radio and requests issuance of the water shortage notice and request to curtail water use. 5. Administrative support person will provide a pre-scripted message to phone callers and log in each phone call. • General Manager gets continual updates on water shortage through District SCADA system. • Once water shortage/contamination is resolved, re-notify customers.

VULNERABILITY ANALYSIS

System Component	*Description and Condition*	*Vulnerability*	*Improvements or Mitigating Actions*	*Security Improvements*
McKinnon Source System (Wells)	4 – 200' deep groundwater wells and 8 shallow artesian wells supply the system. Wells are in excellent condition except DW#2 screen.	- Power feed damage – control building is aging and vulnerable - Damage to source aquifer - Contamination from NUD sewer break above wells due to mudslide etc.	Construct new control facility Inspect/repair connections Clear aging trees in WHPA - Horizon View wellfield - Agreement with NUD for managing this sewer. They have double lined the pipe as precaution. We have also installed alarm in event of sewer obstruction	Improve in-house video surveillance. Coordinate with LFP police for area surveillance. Fencing as needed to secure facilities.
Horizon View Source System (Wells)	2 – deep groundwater wells recently developed.	- vandalism by public	- use other wells	Improve surveillance cameras
Storage Reservoirs	Low Zone reservoir Fair condition, recent upgrades in top vent & fill where vulnerable to contamination High Zone standpipe Fair condition, highly vulnerable to earthquake damage	Earthquake damage Earthquake tipping/hazard to tank structure	Seismic analysis of structure and improve as required or build separate reservoir on more stable soil. Seismic analysis of structure and liquefaction potential of ground. Improve as required.	Install video cameras with motion detection Install video cameras with motion detection
Treatment	Standby chlorination hypochlorite injection	Inoperable when needed, staff unaware how to use Hypochlorite unavailable when needed	Implement regular rehearsal/testing of system Purchase and store stable granular chlorine for emergency use Construct new facility to replace aging, failing wooden structure	Install intrusion detection
Supply System (Pumping Facilities)	Transfer pumps to High/Intermediate zone + all pump controls	Extended power failure Damage to pump/control facility by trees, vandalism	Construct new facility to replace aging, failing wooden structure. Construction scheduled 2015 - 2016	Install intrusion detection in pump control house

Controls/Telemetry System	- monitoring all wells and pump activity at present data relayed to office. - Redundant Auto dial unit for low reservoirs, pump fail, power fail	Extended power or communication failure will require backup power	Portable standby power generator is on-site and ready. Has been used on several occasions.	
Other Considerations	Staffing is critical for small office with only 3 full time employees	Staff illness/failure to respond Staff Communication failure	District office is connected to wellfields through wireless link (McKinnon) and cable internet (Horizon). Cross training of staff including administrative staff to give basic understanding of system operation Purchase business radio system	
Transmission/Distribution system piping	District has water pipes up to 12" throughout system. Most pipes are under traveled roadway corridors.	catastrophic failure (pipe break) that could cause serious erosion damage and consequent risk to life and property	- District SCADA system would provide early notification if reservoir levels drop. - Zone metering is being installed in network with presets to trigger alerts in the event of unusual flow. Metering will have real-time data link to internet.	
Fire Event	Commercial class fire will have the effect of depleting system storage.	Failure of pumps or pressure reducing valves could result in water shortage.	- SCADA system provides advisory notices of reservoir levels below normal; operator intervention.	

Safety

Operator and public safety is a high concern to all staff and Commissioners. The small size of this District requires employees to cover a broad range of tasks. Unfortunately this can lead to increased risk of accident or injury if employees are not routinely familiar with all facets of task completion.

Principal situations of safety concern to District staff are outlined below, with preventative safety measures that are employed.

Task	*Concern*	*Safety Measure*
Emergency System Chlorination with sodium hypochlorite solution	Chemical burns to eyes/face, inhalation injury	Follow standard procedures with handling, ensure ventilation, face/eye protection
Valve exercising, meter reading and hydrant flushing	Bodily injury from automobile or heavy equipment	Reflective or safety clothing. Hard hat, steel toe boot. Flagger accompany for work in traffic.
Meter reading and brush trimming	Animal bites or stings	Provide heavy work clothing.
Reservoir inspection and building roof cleaning	Free fall from reservoir roof or ladder	Use safety harness when climbing above eight feet
Replacing line valves and other heavy objects	Impact to hands, face, feet	Use gloves, lift gate on utility truck, accompany for objects heavier than
Brush trimming	Eye injury	Wear face and eye projection
PRV maintenance	Confined space entry	Maintain adequate confined space training, tripod, 3-gas detector, etc.
Pump repair and inspection, 440 V pumps	Electrical shock	- No access policy if in vicinity of standing water. - Have District electrician disconnect power

Table 6-4 Safety Concerns

Copies of Material Safety Data Sheets (MSDS) used in operations are maintained by the District, and are presented in **Appendix 6-C** for reference.

The District objectives are to observe all appropriate OSHA guidelines and requirements in day to day operations.

IV. RECORD KEEPING MONITORING AND REPORTING

This section outlines the District policies and procedures for record keeping, monitoring and reporting. The District aims to comply with RCW Chapter 40.14 and RCW Chapter 42.56 in the retention and management of its records.

MONITORING PLAN FOR REGULATORY COMPLIANCE AND ENGINEERING USE

The District maintains compliance with DOH requirements for water quality sampling and tests. Water quality records are kept in paper and digital format in the District's files but a more comprehensive record of water quality sampling is accessible through Washington State Department of Health "Sentry Internet" database.

Record type	*Locations Of data*	*Typical Interval*	*Data Type D=Digital P=Paper*	*Period of record*
Water Source and Supply/Storage				
- Well level logs	Office file	Sporadic 1-5min	P D	Older 2009 – present
- Pump run times	Office file	Daily 1-5 min	P D	From 1980's 2009 - present
- Master meter	Office file	Daily 1-5 min	P D	From 1980's 2009 – present
-Reservoir Levels		2min	D	2009 - present

Table 6-5 Record Keeping Organization

CUSTOMER COMPLAINTS

Customer complaint incidents are logged by the District in hard copy form and later entered into a Microsoft Excel spreadsheet. A summary table of customer complaint activity showing the major categories of complaints appears in Part I of this plan, and is presented here also for reference:

There are no follow up reporting procedures for customer complaints at the present. The District intends to implement action, response reporting in the 2015.

CUSTOMER COMPLAINT ACTIVITY 1996 - 2014

Year	Water taste/color	High bill	Leak	Misapplied payment	Never received bill	Construction Related	Miscellaneous	Total per year	Adjusted - Complaints per 1000 hookups per year	Column	Column
1996		2	2	7			5	16	19.0		
1997	1	4	2	5	3		18	33	39.1		
1998	1	3	2	2	3		10	21	24.7		
1999			4	5	4		8	21	24.7		
2000	3	34	3	3	5		4	52	61.1		
2001	2	20	5	2	11	17	12	69	81.2		
2002	3	24	2	1	13	2	6	51	59.6		
2003	5	13	3	3	11	6	9	50	58.3		
2004	1	16	5	2	10	1		35	40.7		
2005	2	15	2	2	5	3		29	33.6		
2006								0	0.0		
2007	1	2	7			1	5	16	18.4		
2008	4	2	8			2		16	18.4		
2009	5		5				1	11	12.6		
2010	4		6			3	2	15	17.2		
2011	7	7	4	2	2	2		24	27.4		
2012	6	8	4	2	3	3		26	29.6		
2013	0	2	1	0	1	0		4	4.5 YTD		
2014	10	8	4	2	3	3		30	34.1		

File: Raid2\System Plan Work\2015 Comp Plan\Complaints.xls

Table 6-6 Customer Complaints

\\Raid\raid-2\System Plan Work\Complaints.xls

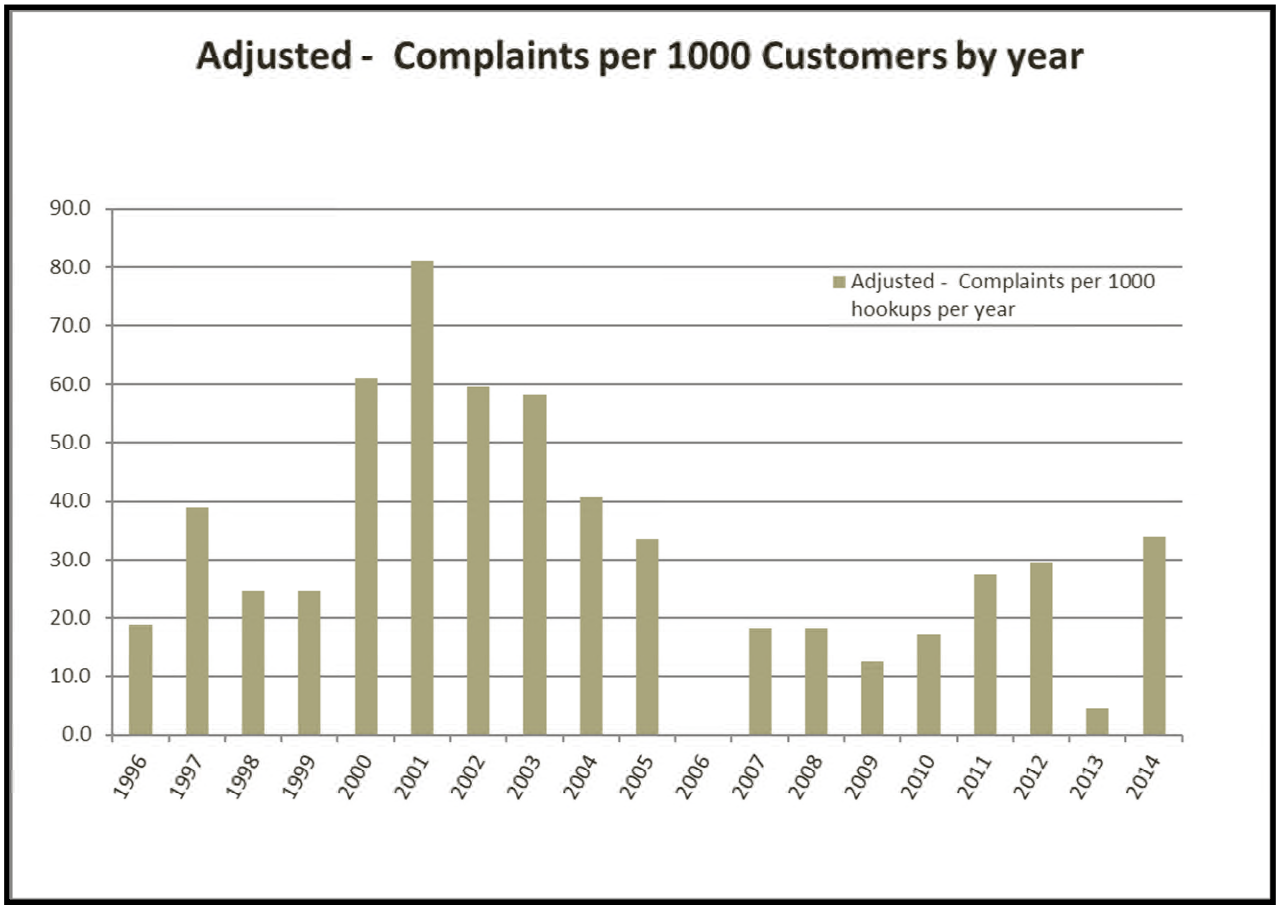


Figure 6-2 Complains per 1000 Customers by year

V. OPERATION AND MAINTENANCE IMPROVEMENT PLAN

This section summarizes improvements that have or will have a significant impact on District operations.

OPERATIONS DEVELOPMENTS ONGOING AND PLANNED 2015 - 2020

Operational developments planned for completion in the near future are aimed at protecting infrastructure and tracking the status of critical operational parameters. For instance, zone metering of flow and pressure will make it easier to spot line breaks and reduce unaccounted water.

Leak Detection Program (on-going)

Acoustic leak detection has been carried out on most years since 1997. The program was initiated in an effort to reduce unaccounted for water loss. Without leak detection many smaller leaks go unnoticed for extended periods. The sandy soil underlying most of the District allows it to absorb considerably large flows before leaks are evident at the surface. This program has located several significant leaks in the distribution system.

The District adopted a Water Use Efficiency (WUE) program by Resolution #334 on June 21, 2010 in accordance with WAC 246-290-800. One conservation measure adopted was for annual leak detection survey of 25% of the District's network of watermains.

Customer Meter Management

This project is on-going, with the following major components:

- Meter box cleaning and insulating.
- Regular and scheduled meter replacement and testing.
- Database tracking of meter information.
- Software detection of unusual usage patterns and follow up with customers.

The District is presently replacing 50 meters annually. Database records of each meter installation are now maintained to ensure that replacement targets the oldest meters in use as well as any with questionable history or reported problems. In addition, the District's billing program has been set to flag significant trend changes so staff can immediately take action, first by communicating with the customer, then with meter testing or replacement if required.

The meter management program has had many direct benefits including:

A) Less wasted time in meter location and reading.
B) Considerably improved customer confidence.
C) Reduced customer claims of over billing. Previously many large usage events were not collected, because staff could not confirm meter functionality.
D) Software flagging of unusual usage readings has had the dual benefit of identifying leaks and malfunctioning meters, and an effect on perceptions of customer service commitment, especially when the customer is made aware of a leak.

Annual Maintenance of Valves and Fire Hydrants / Watermain Flushing

Valve & Hydrant exercise and main flushing are actually two distinct programs, but will be grouped together in this section. Regular, annual main flushing has nearly eliminated complaints of colored water that are common in many water systems after a large flow disruption. By scheduling flushing events and communicating this to customers, the District has shown a commitment to customer satisfaction. Main flushing is especially critical in this District because there is no disinfection residual and the program reduces the opportunity for coliform positive results in routine testing.

Valve exercise has had multiple direct benefits. One of the greatest benefits is that it ensures valves are easily located. Upon initiation of the program many main line valves were poorly identified and some were obscured under asphalt overlays. These problems would otherwise remain unnoticed until an emergency required location of the valve.

Another benefit has been the identification of malfunctioning valves. Many valves have been marked for replacement with upcoming water main replacement upgrades.

Distributed Access Maintenance Records

The District has a goal of creating an interactive server based system to access and update maintenance records from the field. Mapping of water network infrastructure are presently being converted from AutoCAD into ARC-GIS (by ESRI) with the goal of establishing distributed access from the field using cellular data connection.

Zone Metering of Flow and Pressure

The District is prototyping a system that will provide real-time telemetry data to monitor health of the distribution system. The initial system will be deployed at six underground PRV stations and will include:

- sensors to accurately monitor flow and pressure
- SCADA hardware (RTU) to provide analog/digital signal processing and communication
- Intermittent operation pico-hydro generators with battery charge/reserve
- ISM band digital RF communication hardware (radios, antennas)

PART SEVEN - CONSTRUCTION STANDARDS

This section outlines policies and details of the District's standards for construction of water system facilities including water mains, pumping stations, PRV stations, reservoirs, wells, service lines and meters. Please refer to Part III System Analysis for discussion of design, performance and engineering standards.

I. DEVELOPER EXTENSION POLICIES

POLICY

It is the policy of the District to encourage extensions of the water system to serve development within the boundaries of the District. These extensions (a) may be constructed by the District and financed by means of assessments against the property benefited within the limits of a utility local improvement district or (b) may be constructed by the property owner or developer in accordance with these regulations.

STANDARDS FOR WATER SYSTEM DESIGN

All extensions to the water system must at minimum conform to the design standards of the District, and to Washington State of Department of Health Water System Design Manual, 1999 or later.

APPLICATION FOR EXTENSIONS

(a) Application for extension of the District water system to serve newly developed property shall be made by the owner of the property or his agent on the official application form supplied by the District. (See **Appendix 7-A**). The Application for extension must be submitted to the District and approved by the Commissioners before design and construction.

(b) It is the present policy for the District to contribute for cost of general facilities, such as oversized mains, PRVs and pumping stations, proportionately as the same are considered benefiting other portions of the District. The District engineer will determine, subject to approval of the Commissioners, whether improvements required to be installed by a developer, may be considered general facilities of benefit to other portions of the District, and the amount of the District's fair proportionate share of the cost of such facilities. The Commissioners will determine what amount, if any, will be contributed by the District.

CONSTRUCTION STANDARDS

APPROVAL OF WATER MAIN INSTALLED

Installation of water mains shall be by persons approved by the District. Installers must submit evidence of their competence and experience satisfactory to the District Engineer and General Manager.

RELATION BETWEEN APPLICANT AND ENGINEERS

It is expected that the applicant will extend normal courtesies to the District Engineer and other District representative in giving reasonable notice of the time and place of work to be inspected. In particular, the applicant shall:

- Coordinate pre-construction conference
- Notify the District in writing at least 48 hours in advance of the time of beginning of construction; and
- Complete the work, including clean-up, to the point where the work complies with the plans and specifications and is ready for acceptance by the District, within the time limit provided.
- Coordinate 1 year inspection and remedy deficiencies
- Warranty/Bill of Sale for transfer of assets

WATER SERVICE STUBS

Service stub locations will be referenced and locations marked with a 2 x 4 stake. Wire will be attached to the service stub and the stake. The 2 x 4 stake will be painted white with the word “water” written on that portion facing the street. These reference stakes will be removed by District personnel only. Service stubs will terminate in vertical position 20-inches below finished grade of the lot to make them readily available by hand digging by District personnel. It is understood that if the reference stakes are removed or destroyed and the service stub cannot be located in a reasonable time by other reference information such as plat maps or curb markings the added expense in locating service stubs will be the responsibility of the developer.

It shall be the responsibility of the developer to ensure that his contractors and sub-contractors are aware of the conditions of this regulation and act in compliance with these terms.

WATER LINE EXTENSION DISTANCES

Extensions shall be constructed the full width of the property unless otherwise approved by the District Engineer.

VARIANCES

All variances from these requirements must be granted by the Commissioners.

The owner requesting a variance shall make written application to the Board of Commissioners setting forth the name of the owner of the properties to be served, along with the legal description of the property and a dimensioned sketch showing the proposed installation. The application shall state the reasons for requesting the variance and the agreement of the applicant to pay all costs in the expenses of the District incurred in processing the application.

The application for variance shall be accompanied by a fee which shall not be refundable but which shall be applied to the costs and expenses of the District in processing the application.

Upon receipt of the application a date shall be set for a public hearing on the application and notice shall be sent to the property owners situated within 300 feet of the proposed variance facility, containing a brief statement of the proposed variance and the date of hearing, and a similar notice shall be published in the newspaper of record at least 10 days and no more than 20 days prior to the date set for the public hearing.

In considering the application for variance, the Commissioners shall consider the following factors:

a. Whether or not the variance would have an adverse effect upon the accomplishment of the System Plan.
b. Whether or not the proposed variance is consistent with the System Plan.
c. Whether or not there would be adverse effects upon the joining or neighboring properties.
d. Any benefits to the District generally resulting from the proposed variance.
e. Whether or not the applicant will be deprived of a use of his property enjoyed by other property owners similarly situated.

A variance may be granted by the Commissioners only upon written justification. Copies of the written justification shall be mailed to the applicant, all parties entitled to notice and all parties who make a written request for such

II. CONSTRUCTION CONTRACT SPECIFICATIONS

Detailed construction contract specifications provide a framework for tender submissions, agreement between the owner and contractor, general specifications, and detailed specifications.

The District created its construction contract specifications based on the specification used by Cedar River Water & Sewer District with modifications specific to the District. A copy of the contract document appears in **Appendix 7-B.** It is the District's policy to support as much standardization as possible in the development of contract specifications, and it will support regional contract specification initiatives that are practical for District projects.

III. DESIGN STANDARD DETAILS

Construction design details for the most common infrastructure elements are shown in **Appendix 7-C**. These detailed drawings are intended for use in all projects and are available in both electronic and paper format for developer extension projects. It is the District's policy to support a common standard in design details especially with nearby water purveyors.

PART EIGHT - CAPITAL IMPROVEMENT PROGRAM

Part Eight outlines the District's plan for Capital Facility and Administrative Improvements. The layout of Part Eight is as follows:

- Section I Introduction and Background
- Section II Recent and ongoing improvements in the system 2004-2014.
- Section III Near term improvements planned for 2015 through 2020.
- Section IV Improvements planned 2021 through 2026.
- Section V Improvements planned from 2027 through 2034, the horizon of this plan.

Improvements considered to fall under operations/maintenance budget are covered separately in Part Six.

I. INTRODUCTION AND BACKGROUND

The District's principal long term objectives for capital facility improvements are changing in light of extensive upgrades in recent years which now provide redundancy of source and supply as well as improved hydraulic performance for fire protection.

Improvements proposed over the 20 year period 2015 - 2034 are valued at approximately $7.4 million and include:

- new integrated pump facility and related improvements at the McKinnon Creek well field on the newly purchased site #18460 47th Ave. NE
- replace and upgrade all remaining thin wall steel and galvanized iron pipe, as well as all PVC and asbestos cement piping remaining in the system.
- approximately 31,764 linear-feet of new/replacement distribution pipe which loops dead end mains, improves redundancy, and extends service to 73 customers within the District boundaries that are presently served by adjacent Northshore Utility District and North City Water District (formerly Shoreline Water District).
- Construct or refurbish a total of 9 new PRV stations as well as upgrade and repair the District's supply and storage infrastructure.

This plan prioritizes replacement and upgrade of the existing, failing steel transmission and distribution piping. Some of the improvements planned here have been recommended in earlier studies of the system going back as far as the 1960's. These include studies by the WSRB in 1968 and 1975, Comprehensive System Plans for the District in 1973, 1985, and 2005.

CAPITAL IMPROVEMENT PLAN

Customer capture is emerging as a new priority to the District assisting with increased economy of scale and adding revenue base to fund improvements. Over the past 10 years through broad infrastructure improvements, improved administrative capacity and water rights changes, the District has positioned itself to entertain the possibility of development that could bring additional customers including:

- Multi-use retail/residential or dedicated high-rise residential development at LFP Towne Center or other places along the Ballinger Way (SR104) corridor. The District is developing Ballinger Way into a "backbone arterial" of higher capacity water provisioning as might be required with larger commercial development.
- Customer captures from boundary overlap areas NUD, NCWD.
- Boundary re-districting such as could happen if NCWD was annexed by Shoreline and portions in the City of Lake Forest park were amalgamated to the District.

While these developments are speculative and are not individually considered in growth projections, there is however adequate source and supply system capacity to respond if these developments occurred.

II. RECENT AND ONGOING IMPROVMENTS: 2004 – 2014

The District has directly completed (or jointly completed) several major improvements in the last decade, valued approximately $6.6 Million. The principal focus of recent improvements has been replacement and upgrade of aging and undersized steel mains which are leak prone and undersized for fire-fighting. Other priorities have included supply and storage, and information infrastructure. The following paragraphs describe recent improvements in greater detail.

CAPITAL FACILITY/INFRASTRUCTURE DEVELOPMENTS

PWTF 2001 Intermediate Zone Improvements Phase I – III (2004-2005)

This project replaced approximately 5,276 feet of undersized and leaking steel mains, mostly in the beach and high zones and a small part in the low zone. Phase I,II,III cost $896,000 to complete.

Contractor: Earthwork Enterprises

PWTF 2007-8 Phase VI (Ballinger PRV at 175th), Phase V (182nd St.) and Phase IV (Wellhead South, 40th PL, 188th St. WHPA N/S (2009-2011)

These projects have replaced approximately 5,850 feet of undersized and leaking steel mains, and 3 pressure reducing valves including over 675 ft of HDPE 10" by HDD. Phase IV,V cost $1,170,000 to complete.

Contractors:
- Kar-Vel Construction (Phase V)
- Earthwork Enterprises (Phase IV)
- D&G Backhoe (Phase VI)

Horizon View Wells aka Brightwater Backup Wells Phase I, II (2009-2012)

This project purchased about 1.89 acres surplus property from Seattle and constructed two deep wells (465 feet) as well as a 50,000 gallon reservoir and control facility. Also included was about 1,657 feet of on-site and off-site water piping. Total project cost was about $2.2 Million. ($2 Million funded through mediated mitigation agreement with King County).

Contractors:
- Boart Longyear (wells 1,2)
- B&B Utilities (Horizon Park trail restoration)
- RRJ Company (Phase I – offsite, onsite utilities)
- T Bailey (Phase II – tank, pump control building, site)

SPU Intertie Phase I, II (2010-2011)

This project was carried out through an agreement with King County and resulted in the construction of an intertie with SPU-Tolt pipeline at 195th Street as well as over 3,290 feet of 10" and 8" HDPE and ductile iron transmission main that conveys water to the McKinnon Creek wellfield along with a pressure reducing vault and other valving. Total project cost was estimated at $1.7 Million.

Contractors:

- Shoreline Construction (Phase I – transmission main)
- Gary Harper Construction/Pilchuck Contractors (Phase II – HDPE bore under McKinnon Creek)

Ballinger Way W/M between 184th Street and 178th Street (2011)

This project replaced approximately 1,480 lin-ft of 6" steel with 12" ductile iron. The project upgraded a critical link in the transmission main along Ballinger Way that was needed for the LFP Towne Center. The project was constructed using $350,000 District reserves as the District was unable to secure outside funding.

Water Distribution System Upgrades – Misc. Smaller Projects (2004 – 2014)

- 47th Place W/M 286 lin-ft 8" DI, 2" HDPE (2009)		$43,000
- 51st Place W/M 396 lin-ft 8"DI, 2" HDPE (2005)		$35,000
- 180th "Leak" St. W/M 307 lin-ft 8" DI, 2" HDPE (2008)		$70,000
- Lakeview/Fern Ln. W/M 1069 ft 8" DI, 2" HDPE (2007)		$146,000
- 187th Place W/M 352 ft 8" DI, 2" HDPE (2009)		$58,000
- 40th Pl. Dev.Ext. Highberger/Upright 488 ft 8"/2" (2007)		$30,000
TOTAL	**2898 lin-ft**	**$382,000**

CAPITAL IMPROVEMENT PLAN

Supply Storage/Distribution Improvements (2004 – 2014)

-	Standby Generator 80kw/3ph/480v/diesel (2005)	$15,000
-	Low Zone Reservoir Upgrades (ext. paint, anode) (2004)	$90,000
-	Well pump upgrades (2004)	$20,000
-	High Zone Standpipe upgrade/refurbish (2010)	$91,000
-	SCADA System (2004)	$ 8,000
-	Water Sampling Stations (2007)	$10,000
	TOTAL	**$234,000**

RECENT ADMINISTRATIVE PROGRAM IMPROVEMENTS

Several administrative program improvements are summarized here that are critical to the ongoing success of the District.

(a). Rate Increase and Capital Facilities Charge (2009)

Effective September 1, 2009 the District increased base rates for some customers and increased water usage charges from $2.40/ccf to $3.00/ccf an increase of about 25%.

In addition to the rate increases, the District raised the Capital Facilities Charge from $6.94 to $8.00 per equivalent residential unit per month. This increase was used exclusively to fund capital improvement projects.

These developments were critical to the long term success of the District, and reflect the ambitions of both staff and Commissioners to make a maximum possible investment in the future by adequately funding the critical infrastructure upgrades that are needed to keep the system operational and financially viable.

(b). Emergency Intertie Agreement with Seattle Public Utilities (2011)

In late 2011 the District signed a 50 year agreement with Seattle Public Utilities for emergency water supply including fire protection. The agreement represents a significant value toward fire protection and overall system reliability compared to the previous agreement, offering 3,500 gpm for up to one week and more with written approval.

(c). Development of In-House Bacterial Analysis for Engineering Samples (2010)

Currently WSDOH requires the District to take 3 bacteriological monitoring samples each month. The District developed an in-house laboratory analysis program to supplement state required bacterial sampling. The District currently takes up to 15 in-house samples each month. The net result is improved monitoring and response to protect public health.

is

(d). Implement Project Cost Accounting System (2004-2010)

The District deployed Quickbooks for managing accounts payable. This system offers improved ability to track and manage project costs through the life of the project.

(e). Improve Internal Financial Controls (2011)

After the District became aware of an internal embezzlement problem in 2010 it responded by complete re-design of internal controls to provide redundant protection through:

- Increased Financial Oversight by formalizing treasurer position on Board of Commissioners, detailed budget, expenditure limits for General Manager.
- Improved Financial Reporting through monthly budget and financial reports, long term fund projections.
- Segregation of duties – retention of outside bookkeeping review, internal review by Admin. Assistant, General Manager review.
- Mileage Reimbursement system including requirements for: Manager pre-approval, Mileage Log, Gas Card.

(f). Water Rights Amendments (2012-2014)

Several legacy issues with the District water rights remained unresolved which placed a cloud over its ability to legally source water. Designation of a "closed basin" further encumbered the issue by preventing additional applications.

In 2012 the District launched an intense effort to remedy these problems which included:

- Addition of points of withdrawal (create common wellfield) so water rights could be pooled between all wells.
- Addition of McKinnon DW#4
- Addition of new deep wells 1,2 at Horizon View which were developed through a mitigation with King County – Brightwater project.
- Recognition of surface water certificate #498 as valid at deep wells. Certificate #498 was formally permitted at the now discontinued "west watershed".

The approval of these changes in 2014 marks a valuable milestone for the District by ensuring adequate water rights to provide for present and future needs.

III. NEAR TERM IMPROVEMENTS 2015 – 2020

This section outlines improvements that are absolute priorities in the near term. After careful analysis of the descriptive analysis of system infrastructure and review of hydraulic model analysis of the system in Part Three, improvements were selected that are considered to have the greatest impact on system reliability and capacity. Analysis (see Part Three) shows an exponentially escalating failure rate for thin wall steel "liberty" pipe installed in the 1950's. The challenge this period is to prioritize pipe replacement.

Table 8-1 and Figure 8-1 summarize proposed capital facility improvement projects and projected costs over the next six years. Each project is referenced by type and location, as well existing and proposed parameters. The following sections discuss each project group. Note that many distribution projects carry a suffix – "A", "B", "C" etc. – these projects are prioritized by phases based on the failure rate for each section of pipe so as to optimize infrastructure replacement investment. The breakdown of projects into phases does increase administrative costs. However the overall benefit is a reduction of capital improvement obligations from $3.5Million to $2.4Million over the next 6 years. All figures are in 2015 dollars.

CAPITAL FACILITY AND INFRASTRUCTURE IMPROVEMENTS, $2.42MILLION

The following paragraphs describe the scope and rationale of each project:

SS1 McKinnon Creek Pumping/Storage Improvements $580,000

A major project to enhance supply reliability will be the construction of the new integrated pumping/control/treatment facility in the McKinnon Creek wellfield. This project is funded through PWTF loan agreement approved in 2013.

The single concrete/concrete block facility will replace several dilapidated small buildings in the WHPA that currently house pumps and control equipment. The existing buildings need replacement, are poorly located, and have a history of moisture problems. The new facility, with concrete basement and suspended slab, will house the District's above ground pumps, controls, and future iron removal equipment. It will also provide office space and storage as well as a bathroom and shower and provide space for a flexible pipe manifold, allowing interrelated options for filling, emptying, and routing flow. This project involves several related improvements to supply facilities in the District's WHPA including.

- Concrete pump/treatment facility (26x32 ft) with upper level office/controls area and lower level with piping gallery
- HDPE or Ductile Iron 12" from Low Zone reservoir
- 10" PRV from Horizon View zone to Low Zone, 8" PRV from Horizon View zone to High zone
- Construct 2044 lin-ft 8" HDPE or DI transmission mains in McKinnon Cr. WHPA
- Demolish and remove existing pump house, salvage components

D1A, B, D2, D3, D4A, D5, D9A *Low Zone Improvements* *$924,310*

This project upgrades about 4,536 lin-ft of undersized and rapidly failing watermains – mostly on 178th Street and also on Ballinger and 175th Street.

Some facts:

- Piping covered by this project causes over half of all distribution failures in the system.
- Average failure rate over these sections of piping is 1.00/1000feet/year (4.5 failures total/year)
- Average failure cost is $13,725/year
- Highest failure rate is 3.5/1000feet/year – on 178th Street between 40th Ave. and #4036 178th Street.
- Some sections are also a priority to coordinate with the City of LFP street upgrades

D10, D11, D12A, D12B, D13, D14A, D15A Project Unnamed *$759,240*

This project upgrades about 3,400 lin-ft of undersized and rapidly failing watermains mostly on Ballinger Way (SR104) and also on 180th Street, 181st Street, and 30th Avenue.

Some facts:

- Piping covered by this project causes about 1/4th of all distribution failures in the system.
- Average failure rate over these sections of piping is 0.764/1000feet/year (2.6 failures total/year)
- Average failure cost is about $7,800/year
- Highest failure rate is 1.29/1000feet/year – on 181st Street
- Some sections are also a priority to coordinate with the City of LFP street upgrades

D38.1 Opt "A", SS2, SS3, A1, A2 *Miscellaneous Projects* *$156,000*

- D38.1 Opt. "A" Casing under Bothell Way at #17181 $54,000
  This project provides economy by coordinating with a drainage culvert installation proposed by the City of LFP. The casing allows installation of up to 12" watermain under Bothell Way to the Beach zone. Present plans are to install the casing but defer installing the pipe.
- SS2 McKinnon Cr. Well #3 Upgrades $25,000
  This project provides a video inspection of the casing and upgrades to casing to minimize the possibility of groundwater intrusion. This has been called for in technical reviews as far back as 1980.
- SS3 High Zone Standpipe Inspections and Repairs $37,000
  This project would include a seismic safety evaluation and inspection of interior/exterior coatings with minor upgrades or repairs as needed.
- A1 Security Needs Assessment $10,000
  This project will assess security needs and prioritize improvements at the McKinnon Creek and Horizon View wellfields where the District has vulnerable source and supply infrastructure.
- A2 Security – Critical Improvements as directed by needs assessment. $30,000

COMPLETED IN 2015

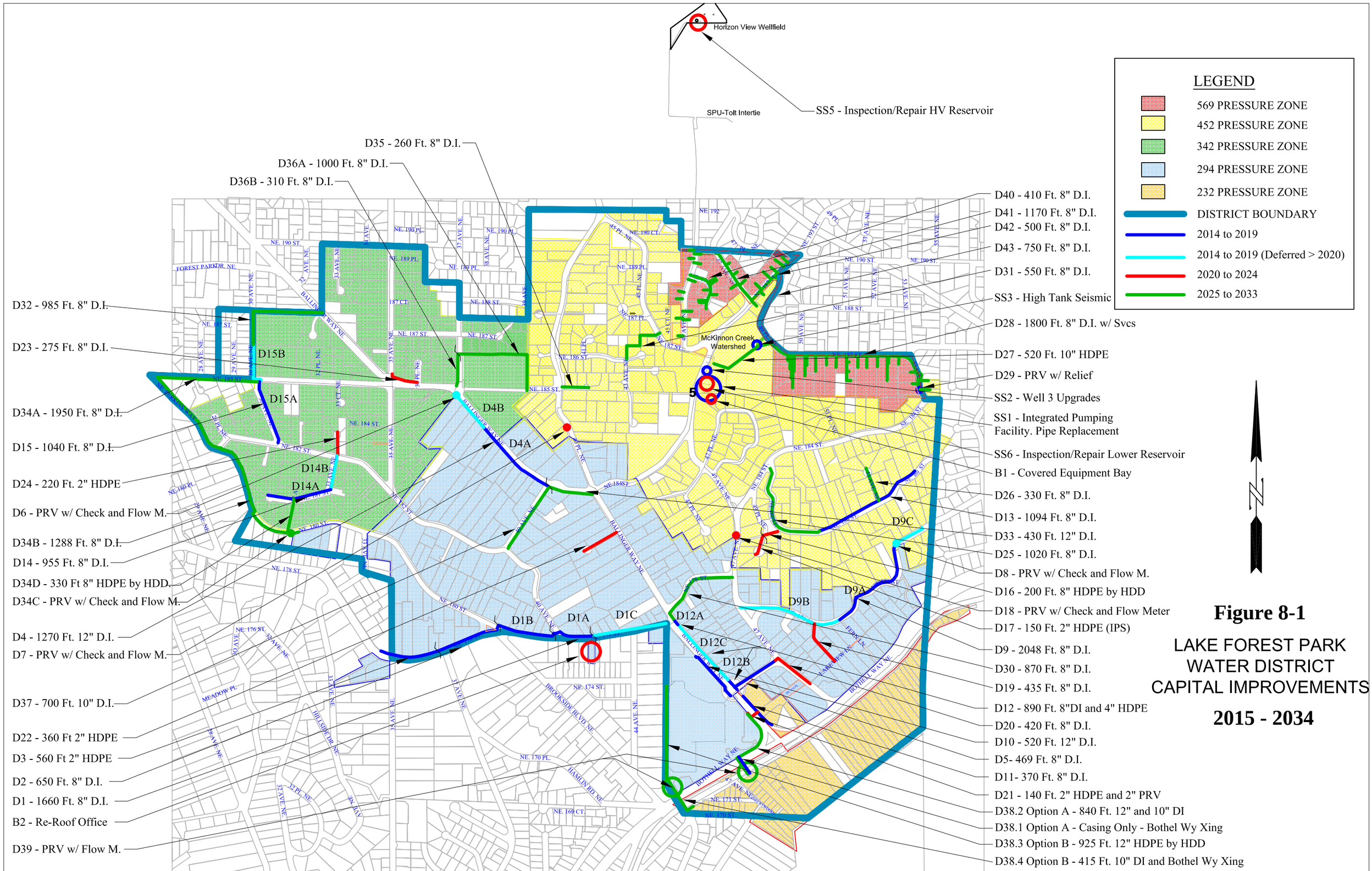


Figure 8-1

LAKE FOREST PARK WATER DISTRICT CAPITAL IMPROVEMENTS

2015 - 2034

Table 8-1 Capital Projects 2015 - 2020

Project #	Project Name	Status	Location/Description	Existing	2007-2012 Failure Rate/1000ft/yr	Failure Cost $/yr at $3000 per event	Replacement	Qty. (Lin-Ft)	Est. Unit Cost, $/ft	Extended	Project Sub total
SS1	PWTF 2013 "Source and Supply Improvements in WHPA"	Funding in hand by PWTF 2013 loan $464,303.93 balance to be provided by District funds	McKinnon Creek Wellhead - Construct concrete pump/treatment facility with support for integrated functions including ozone treatment, flushing, metering, and iron/arsenic removal. - Demolish and remove existing wood pump house located on the edge of McKinnon Creek. - 10" pressure reducing valve chamber to transfer water from new Horizon View/SPU intertie to low zone during fire emergency.	Dilapidated wood building over 70 years old. Building is vulnerable to flooding in current location.	N/A		Integrated pumping facility with provision for treatment - Architectural block with concrete basement construction	1	$332,580	$332,580	
			- Transmission main over steep slope from low zone reservoir to replace existing 12" asbestos cement pipe. Addition of magnetic master meter.	12" AC is on steep slope without joint restraint. Risk of seismic failure for critical supply line.	none		12" HDPE which is resistant to failure from seismic events.	80	160	$12,800	
			- Transmission mains from wells, reservoirs and distribution, some pipe in common trench	6" thin wall steel "Liberty Pipe" is failing and undersized.	none		8" HDPE with dedicated lines for control options.	2044	115	$235,060	**$580,440**
D1A	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. between 40th Ave. and #4036 178th Street	6" thin wall steel "Liberty Pipe"	3.53	$4,204	8" D.I.	397	220	$87,340	
D1B	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. between 40th Ave. and Int. NE 180th Street.	6" thin wall steel "Liberty Pipe"	0.72	$1,205		558	200	$111,600	
D2	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. between Brookside Blvd. & Elementary School (North shoulder) ***Coordinate with City of LFP project***	2" G.I.	0.54	$1,175	8" D.I.	725	180	$130,500	
D3	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. between Elementary School and 35th Ave. (North shoulder) ****Coordinate with City of LFP project***	2" G.I.	0.55	$809	2" HDPE	490	100	$49,000	
D4A	"Low Zone Improvements"	Capital Improvement funds and State Loan	Ballinger (SR104) at #18467 to 40th Ave. (west shoulder)	6" thin wall steel "Liberty Pipe" is failing and undersized.	1.18	$2,991	12" D.I.	845	250	$211,250	
D5	"Low Zone Improvements"	Capital Improvement funds and State Loan	175th St. between Ballinger & 47th Ave. (North shoulder)	6" thin wall steel "Liberty Pipe" is failing and undersized.	0.67	$943	8" D.I.	469	220	$103,180	
D9A	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th Street ("Goat Trail") East of Fern Lane to #5084 178th (middle of road) ****Coordinate with City of LFP project***	6" thin wall steel "Liberty Pipe" is failing and undersized.	0.76	$2,399	8" D.I.	1052	220	$231,440	**$924,310**
D10	TBD	Capital Improvement funds and State Loan	Ballinger Way SR104 between 178th St. and 175th St. (West shoulder), extension from north entrance Towne Center to 175th St.	No pipe on West shoulder	0	$0	12" D.I.	520	250	$130,000	
D11	TBD	Capital Improvement funds and State Loan	Ballinger Way SR104 between new PRV near 175th and 8" DI near Bothell Way (East shoulder)	6" thin wall steel "Liberty Pipe" is failing and undersized.	0		8" D.I. installation complicated by heavy traffic on Ballinger may require limited schedule working. Also, remove abandoned PRV in route.	370	240	$88,800	
D12A	TBD	Capital Improvement funds and State Loan	Ballinger at 178th St. to FH near #17576	6" thin wall steel "Liberty Pipe" is failing and undersized.	0		8" D.I. installation complicated by heavy traffic on Ballinger may require limited schedule working.	45	240	$10,800	
D12B	TBD	Capital Improvement funds and State Loan	Ballinger at #17510 from 175th to FH at #17510	6" thin wall steel "Liberty Pipe" is failing and undersized.	0		8" DI to fire hydrant	129	220	$28,380	
D13	TBD	Capital Improvement funds and State Loan	180th Street between #5050 and #5434	6" thin wall steel "Liberty Pipe" is failing and undersized.	1.28	$4,201	8" D.I.	1094	220	$240,680	
D14A	TBD	Capital Improvement funds and State Loan	181st Street to 33rd Ave.	6" thin wall steel "Liberty Pipe" is failing and undersized.	1.29	$2,396	8" D.I.	619	220	$136,180	
D15A	TBD	Capital Improvement funds and State Loan	30th Ave. at 182nd Street to #18524	6" thin wall steel "Liberty Pipe" is failing and undersized.	0.64	$1,194	8" D.I.	622	200	$124,400	**$759,240**
OptA-D38.1	Beach Zone West Loop Option "A"	Capital Improvement funds and State Loan	Casing under Bothell Way at #17181 (Bank of America) ***coordinate with City of LFP project***	None	0		36" steel casing only	180	300	$54,000	
SS2	McKinnon Cr. Well #3 Upgrades	Capital Improvement funds and State Loan	Retrofits to well #3 casing and wellhead to safeguard against surface water intrustion.	Current wellhead and casing not sealed and creates health risk from intrustion of surface water.	N/A		As described	1	25000	$25,000	
SS3	High Zone Standpipe inspections and repairs 2015	Capital Improvement funds and State Loan	Seismic evaluation and inspection of interior/exterior coatings; minor upgrades or repairs as needed	200,000gal welded steel 1963	N/A		As described	1	37000	$37,000	
A1	Security Needs Assessment	Funding by outside grants	McKinnon Creek/Horizon View and as directed					1	10000	$10,000	**outside funds**
A2	Security - Critical Improvements as directed by needs assessment	Funding by outside grants	McKinnon Creek/Horizon View and as directed					1	30000	$30,000	**outside funds**
											$156,000
					Annual cost from failures last 5 years	**$21,516**		**Lin-Ft Pipe**	**10060**	**Grand Total all projects**	**$2,419,990**

file: Raid2:\system plan\Capital Projects.xls
edit: Oct. 1, 2015

Table 8-1 Capital Improvements 2015 – 2020
\\Raid\raid-2\System Plan Work\Capital Projexts.xls

ADMINISTRATIVE DEVELOPMENT PLANS (COST NOT DETERMINED)

(a) Approval of LFPWD Comprehensive Water System Plan 2015

Final editing and approval of the District's updated System Plan will perhaps be the most significant administrative milestone toward the future within the next five years. In terms of capital facilities development, this will positively impact financing and will also streamline and lower the cost of approvals. Moreover, the completion will formalize the adoption of many administrative changes that have been developed over the course of planning.

(b) Electronic Billing and Customer Access To Accounts

This has been a requested service for some time and would significantly improve customer satisfaction, based on customer feedback. The topic has been investigated but the District has not taken action as transaction costs have been excessive. It is expected that additional opportunities for electronic billing will develop and make this viable in the next five years. Presently District staff carries full responsibility for a host of information retrieval and delivery tasks. Customers wanting to clarify billing or payment history could increasingly be directed to internet based records.

(c) Resolution of Control of Wellhead Issues at McKinnon Creek Wellfield

The District or its predecessor entities have produced water at the McKinnon Creek Wellfield since 1910. However questions of ownership or control through covenants jeopardizes use the District's wells. The District has taken legal action to clear up this matter and is currently negotiating with the City of LFP. Resolution of this issue provides for a safer, more reliable water source and supply at McKinnon Creek and thus helps ensure the future of the water system.

(d) Resolution of Boundary Overlap Issues with Neighboring Water Providers

The District has several boundary overlap areas with adjacent water districts NUD and NCWD. These areas involve about 73 customers. Resolution of this issue would help the District plan for the future network and it would likely result in a net increase of customers. Negotiation is currently underway with NCWD and negotiation is needed with NUD.

(e) Negotiation of New Franchise Agreement with City of LFP

A new franchise could be considered. The current franchise expires in 2018.

IV. IMPROVEMENTS 2021 THROUGH 2026

This section outlines a capital improvement plan with cost estimates for the years 2021 through 2026. **Table 8-2** outlines capital facility improvement projects and projected costs of projects scheduled from 2021 through 2026. Each project is referenced in Table 8-2 by type, location, and existing and proposed parameters. The following sections discuss each project group. All figures are in 2015 dollars.

CAPITAL FACILITY/INFRASTRUCTURE IMPROVEMENTS, $1.49 MILLION

About $1.09 Million or 74% of the capital improvement outlay in this period is dedicated to replacement of remaining thin wall steel piping that is observed to have a lower failure rate than pipe prioritized for early replacement 2015-2020. The remaining distribution projects improve circulation and fire capacity by construction of looping and PRV chambers between zones. Miscellaneous structural project include re-roofing and periodic reservoir inspection and repairs.

(a) Project # D1C, D4b, D6, D7, D8, D9B, D9C, D12C, D14B, D15B, D16, D17, D18, D19, D20, D21, D22, D23, D24 Unnamed Projects, $1.316 Million

These projects (see Table 8-2 and Figure 8-1) are summarized here as:

- total approximately 6080 lin-ft of watermain of which about 5,225 feet replaces failing pipe
- size ranging from 2" HDPE to 12" ductile iron pipe
- Piping covered by this project causes about 15% of all distribution failures in the system.
- Average failure rate over these sections of piping is 0.246/1000feet/year (1.5 failures total/year)
- Average failure cost is about $4,500/year
- Highest failure rate is 1.18/1000feet/year – on Ballinger Way (SR104)

(b) #B1, B2, SS4, SS5, SS6 Misc. Building & Supply/Storage Projects, $174K

These projects described in Table 8-2 and Figure 8-1 are summarized here as:

- Covered Equipment Bay at McKinnon Cr. (18460 47th Pl.)
- Re-Roof office 4029 NE 178th St.
- Inspection / cleaning and repairs and seismic upgrades High zone standpipe on 49th Pl.
- Inspection and repairs Horizon view reservoir
- Inspection and repairs Low zone reservoir

Table 8-2 Capital Projects 2021 - 2026

Project #	Project Name	Status	Location/Description	Existing	5yr Avg. Failure Rate/1000ft	Failure Cost $/yr at $3000 per event	Replacement	Qty.	Est. Unit Cost, $/ft	Extended	Project Sub total
D1C	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. from Ballinger to #4036 (north shoulder)	6" thin wall steel "Liberty Pipe" is failing and undersized	0	$0	8" DI pipe	702	200	$140,400	
D4b	"Low Zone Improvements"	Capital Improvement funds and State Loan	Ballinger (SR104) at closed valve to #18467 (west shoulder)	6" thin wall steel "Liberty Pipe" is failing and undersized.	1.18	$1,505	12" D.I.	425	250	$106,250	
D6	"Low Zone Improvements"	Capital Improvement funds and State Loan	PRV at Ballinger & 37th Ave. w/ reverse check valve bypass and flow meter	Closed valve, creates dead zone in pipe	0	$0	Pre-fabricated PRV station 8x2 with 10" reverse check valve bypass, flow meter	1	70000	$70,000	
D7	"Low Zone Improvements"	Capital Improvement funds and State Loan	PRV at Ballinger & 40th PL NE w/ reverse check valve bypass and flow meter	Closed valve, creates dead zone in pipe	0	$0	Pre-fabricated PRV station 6x2 with 8" reverse check valve bypass, flow meter	1	65000	$65,000	
D8	"Low Zone Improvements"	Capital Improvement funds and State Loan	PRV at #5084 178th Street	Aging PRV station	0	$0	Pre-fabricated PRV station 6x2 with 8" reverse check valve bypass, flow meter	1	65000	$65,000	
D9B	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. East from 47th Ave. to #4780 (at Fern Lane)	6" thin wall steel "Liberty Pipe" is failing and undersized.	1	$2,991	8" DI pipe with restrained joints	997	200	$199,400	
D9C	"Low Zone Improvements"	Capital Improvement funds and State Loan	178th St. East from #5084 to #5314 (at PRV)	6" thin wall steel "Liberty Pipe" is failing and undersized.	0	$0		290	220	$63,800	
D12C	TBD	Capital Improvement funds and State Loan	Ballinger from FH at #17510 to FH at #17576	6" thin wall steel "Liberty Pipe" is failing and undersized.	0	$0	4" HDPE inside 6" Steel with Services	715		$0	
D14B	TBD	Capital Improvement funds and State Loan	33 Ave. NE from 181st Street to 182nd St.	6" thin wall steel "Liberty Pipe" is failing and undersized	0	$0	8" DI pipe with restrained joints	332	220	$73,040	
D15B	TBD	Capital Improvement funds and State Loan	30th Ave. NE from 182nd St. to #18725 (south edge)	6" thin wall steel "Liberty Pipe" is failing and undersized	0	$0	8" DI pipe	418	180	$75,240	
D16	TBD	Capital Improvement funds and State Loan	"Bausman Lane" undeveloped ROW steep slope along north border of 5011 NE 180th St. to 49th PL	6" CI c1975 no joint restraint on steep slope near houses, under carport; risk of rupture and erosion.	0	$0	8" HDPE by HDD will improve safety.	200	220	$44,000	
D17	TBD	Capital Improvement funds and State Loan	49th PL NE from "Bausman Lane" to end of cul-de-sac	1" or 2" Galv. Iron pipe is aged and failing	0	$0	2" HDPE (IPS)	150	125	$18,750	
D18	TBD	Capital Improvement funds and State Loan	PRV to replace closed valve at 47th Ave. and 184th Street	Closed Valve between pressure zones prevents circulation.	0	$0	Pre-fabricated PRV with check valve reverse bypass will allow circulation.	1	55000	$55,000	
D19	TBD	Capital Improvement funds and State Loan	Weathervane Lane between 178th St. NE and Lakeview Lane	6" thin wall steel "liberty pipe" is failing and undersized.	0	$0	8" DI with restrained joints	435	200	$87,000	
D20	TBD	Capital Improvement funds and State Loan	47th Ave. NE between 175th St. and Lakeview Lane	6" thin wall steel "liberty pipe" is failing and undersized.	0	$0	8" DI pipe	420	220	$92,400	
D21	TBD	Capital Improvement funds and State Loan	Ballinger Way (SR104) at City Hall across to east shoulder and connect to new 8" DI	dead end 12" main at City Hall prevents circulation	0	$0	2" HDPE pipe and small 2" PRV vault. Install crossing by mole.	140	200	$28,000	
D22	TBD	Capital Improvement funds and State Loan	Ballinger Way (SR104) Unnamed Cul-de-Sac #18211 - 18217 ("Hungar Street")	2" Galv. Iron under pavement is failing.	0	$0	2" HDPE (IPS)	360	125	$45,000	
D23	TBD	Capital Improvement funds and State Loan	Ballinger Way (SR104) between 35th Ave. and 36th Pl.	6" thin wall steel "liberty pipe" under sidewalk and parking lot	0	$0	8" DI	275	220	$60,500	
D24	TBD	Capital Improvement funds and State Loan	182nd St. Un-named Cul-de-Sac #3300 - 3314	2" Galv. Iron under pavement is failing.	0	$0	2" HDPE (IPS)	220	125	$27,500	**$1,316,280**
B1	TBD	Capital Improvement funds and State Loan	Covered Equipment Bay at McKinnon Cr. (18460 47th Pl.)	None	0	$0	26'x40' steel clad building - open one side	1040	26	$27,040	
B2	TBD	Capital Improvement funds and State Loan	Re-Roof office 4029 NE 178th St.	Asphalt shingle	0	$0	Asphalt shingle or metal	1040	7	$7,280	
SS4	TBD	Capital Improvement funds and State Loan	Inspection / cleaning and repairs and seismic upgrades High zone standpipe on 49th Pl.	Welded steel reservoir	0	$0	Same	1	80000	$80,000	
SS5	TBD	Capital Improvement funds and State Loan	Inspection and repairs Horizon view reservoir	Welded steel reservoir	0	$0	Same	1	10000	$10,000	
SS6	TBD	Capital Improvement funds and State Loan	Inspection and repairs Low zone reservoir	Welded steel reservoir	0	$0	Same	1	50000	$50,000	
A3	Security Improvements - as directed by needs assessment	Grants	McKinnon Cr. And Horizon View wellfield				Various improvements to comply with federal security requirements			$160,000	outside funds
										$0	
										$0	**$334,320**
				Annual cost from failures last 5 years		**$4,496**		**6083**	**Grand Total all projects**		**$1,650,600**

file: Raid2:\system plan\Capital Projects.xls
edit: Oct. 1, 2015

Table 8-2 Capital Improvements 2021 – 2026
\\Raid\raid-2\System Plan Work\Capital Projexts.xls

ADMINISTRATIVE DEVELOPMENT PLANS (COST NOT DETERMINED)

(a) Preparation of Updated System Plan

An updated system plan can be submitted early in this period, pending changes in Washington State legislation that may allow 10 years between Comprehensive Water System Plan updates. It is expected that this plan would refine the Districts Capital Facilities upgrade plans beyond 2033 and also reconcile administrative status, plans and changes.

(b) Resolution of Boundary Overlap Issues with Neighboring Water Providers

Resolution of this issue would help the District plan for the future network and it would likely result in a net increase of customers.

V. IMPROVEMENTS 2027 THROUGH 2034

Part V covers improvements on the more distant horizon of this plan. These improvements will be further refined in subsequent planning studies but are useful in maintaining continuity of the overall development and improvement program.

Table 8-3 outlines capital facility improvement projects and projected costs over the period 2027 - 2034. Each project is referenced by type, location, and existing and proposed parameters. The following sections discuss each project group.

CAPITAL FACILITY/INFRASTRUCTURE IMPROVEMENTS $ 3.44 MILLION

Capital improvement effort in this period marks a shift from the previous 4-decades where the over-riding priority was replacement of aging, failing this wall steel "Liberty pipe". Improvements in 2027 - 2034 are aimed at reducing risk and increasing revenue through customer re-capture.

Infrastructure improvements completed this period are prioritized as follows:

- Replacement of "other" pipe in distribution system such as asbestos cement, cast iron and PVC. These types of pipe are generally in good condition and are sometimes adequately sized but present a risk due to their "brittle" nature and consequent tendency to burst and cause sudden breakage with possible catastrophic damages.
- Construction of redundant looping to improve network circulation and reliability. Looping also improves fire capacity, especially for commercial fire scenarios
- Customer re-capture – assumes agreements with neighboring Districts NUD, NCWD

(a) D25, D26 Unnamed 180th St. and 53rd Ave. NE Cul-de-Sac, $297K

These projects:

- Replace existing 6" AC that is undersized and at risk of failure with 8" ductile iron pipe.
- Total length 1,350 feet
- Existing failure rate very low

(b) D27-D29 – Horizon View zone Ph. I Cust. Re-capture 187th St., $534K

These projects:

- Construct a supply to 187th St. from McKinnon Creek wellfield piping that feeds from Horizon View.
- Piping is constructed along the south shoulder of 187th St. east and with a PRV looping into existing High zone piping on 184th St.
- Total 520 lin-ft 10" HDPE by HDD
- Total 1,800 lin-ft ductile iron 8"

(c) D30 - D37 – Unnamed Projects, $1.87Million

These projects:

- Replace 4,120 lin-ft of existing AC, CI, and PVC piping which is at high risk of devastating rupture failure.
- Construct 4,553 lin-ft of new redundant piping to create looping
- Total 8674 lin-ft replacement and new piping, mostly 8" DI.
- Existing failure rate is low, but impact of failure is high.

(d) OptA - D38.2, D39 Beach Zone West Loop Option "A", $280,000

This project:

- Would provide a redundant supply for the beach zone which presently depends on a single source of supply from the network.
- Total 840 lin-ft 12"/10" ductile iron and HDPE under Bothell Way
- This project would have particular value in the event of any new commercial construction along Lake Washington (on the south side of Bothell Way) and Developer Extension provisions for cost sharing may be considered in funding.
- An existing 12 ductile iron main on Ballinger Way near LFP City Hall would be extended south and west along Bothell Way to a casing under Bothell Way near the creek crossing.
- A PRV would be constructed on the south side of Bothell Way to admit water to the Beach zone.
- Option "B" would construct extension of 10" at LFP Towne center (west) side through private easement using HDD to Bothell Way with casing under Bothell Way. Opt. "B" 1,340 lin-ft, cost $335,000.

(e) D40 – D43 Horizon View zone Ph. II Cust. Re-capture from NUD, $461,500

This project:

- Would extend service to customers currently served by NUD
- Total 2,435 lin-ft water main construction possible, although subject to negotiation of service area agreements with NUD

(f) Horizon View zone – SPU-Tolt Intertie 193rd St., Not Budgeted

This project:

- Would provide increase in intertie capacity with SPU to achieve up to 3,500 gpm total as per agreement with SPU.
- Total 1,620 lin-ft 12" transmission main, although only 440 feet would be exclusively for the intertie connection, assuming that the intertie was constructed in conjunction with Horizon View zone Ph. II customer re-capture.
- Would require PRV station near Tolt intertie on 193rd St. to reduce pressure to Horizon View zone

Table 8-3 Capital Projects 2027 - 2034

Project #	Project Name	Status	Location/Description	Existing	5yr Avg. Failure Rate/1000ft	Failure Cost $/yr at $3000 per event	Replacement	Qty.	Est. Unit Cost, $/ft	Extended	Project Sub total
D25	TBD	Capital Improvement funds and State Loan	180th Street east of 184th St. to DI pipe at #5050	6" AC is undersized and at risk of failure	0	$0	8" DI	1020	220	$224,400	
D26	TBD	Capital Improvement funds and State Loan	53rd Ave. NE Cul-De-Sac from 180th St. to end	6" AC is undersized and at risk of failure	0	$0	8" DI	330	220	$72,600	$297,000
D27	Horizon View Service Zone Phase I - Customer Re-capture	Capital Improvement funds and State Loan	McKinnon Cr. WHPA from Horizon View HDD pipe up steep hill to 49th PL near High Zone Standpipe	currently served by NUD	0	$0	10" HDPE by HDD or open cut will convey water from Horizon View wells to 49th PL. and 184th St. (south side)	520	160	$83,200	
D28	Horizon View Service Zone Phase I - Customer Re-capture	Capital Improvement funds and State Loan	49th PL #18720 (in front of standpipe), west along 187th St., and finally south to #18517 53rd Ave. for PRV connection to Ex. 8" DI	currently served by NUD	0	$0	8" DI will allow District to serve homes in District boundary along south side 184th St. Will create loop in network for improved circulation.	1800	220	$396,000	
D29	Horizon View Service Zone Phase I - Customer Re-capture	Capital Improvement funds and State Loan	53rd Ave PRV at #18517 53rd Ave. (west shoulder)	currently served by NUD	0	$0	6"X2" PRV with downstream relief - will maintain circulation and support 184th St. fire capacity	1	55000	$55,000	$534,200
D30	TBD	Capital Improvement funds and State Loan	178th St. East of Ballinger (SR104) to 47th Ave.	8" PVC risk of devestating pipe rupture close to 12" transmission main.	0	$0	10" DI? Replaces PVC for safety and capacity	870	240	$208,800	
D31	TBD	Capital Improvement funds and State Loan	Private Easement along checkerboard route between 45th PL and 186th St./43rd Ave.	6" AC is undersized and at risk of failure	0	$0	8" DI w/ joint restraints replaces undersized asbestos cement for safety and hydraulic reasons.	550	200	$110,000	
D32	TBD	Capital Improvement funds and State Loan	Ballinger Way (SR104) at #18725 to #18524 30th Ave. Note: includes bore crossing under Ballinger	none	0	$0	8" DI provides redundant loop to serve Intermediate Zone customers west of Ballinger. Presently all water must pass through single point at int. Ballinger/35th Ave.	985	230	$226,550	
D33	TBD	Capital Improvement funds and State Loan	Ballinger Way (SR104) at 40th Ave. to 184th St.	8" PVC risk of devestating pipe rupture close to 12" transmission main. Also is undersized.	0	$0	12" DI replaces 8" PVC for safety and capacity	430	250	$107,500	
D34A	TBD	Capital Improvement funds and State Loan	185th St. west to Perkins Way (180th St.) ending at #18203 Perkins Way (180th St.)	none	0	$0	8" DI is a redundant loop to improve circulation and allow service to all homes in District boundaries.	1950	200	$390,000	
D34B	TBD	Capital Improvement funds and State Loan	Perkins Way (180th St.) east to #3020 NE 180th St.	none	0	$0	8" DI is a redundant loop to improve circulation and increase fire flow within the intermediate zone.	1288	200	$257,600	
D34C	TBD	Capital Improvement funds and State Loan	PRV at #3020 NE 180th St. (south shoulder)	none	0	$0	6"X2" PRV with downstream relief and reverse flow check - will maintain circulation and support 180th St. fire capacity	1	55000	$55,000	
D34D	TBD	Capital Improvement funds and State Loan	HDD from NE 181 St. to NE 180 St.	none	0	$0	8" HDPE is a redundant loop to improve circulation and allow service to all homes in District boundaries.	330	200	$66,000	
D35	TBD	Capital Improvement funds and State Loan	185th St. cul-de-sac east of 40th PL	6" AC is undersized and at risk of failure	0	$0	8" DI	260	200	$52,000	
D36A	TBD	Capital Improvement funds and State Loan	185th St. #3844 around LFP Elementary school to 37th Ave.	8" AC is at risk of devestating pipe rupture.	0	$0	8" DI with joint restraints on slope areas, or 10" HDPE	1000	180	$180,000	
D36B	TBD	Capital Improvement funds and State Loan	35th Ave NE from LFP Elementary school to the north side of Ballinger Way (SR104)	8" PVC is at risk of devestating pipe rupture.	0	$0	8" DI	310	180	$55,800	
D37	TBD	Capital Improvement funds and State Loan	40th Ave. from 182nd St. to Ballinger Way (SR104)	8" AC is at risk	0	$0	10" DI	700	230	$161,000	$1,870,250
OptA-D38.2	Beach Zone West Loop Option "A" - Extend from LFP City Hall	Capital Improvement funds and State Loan	City Hall to #17181 Bothell, through 36" casing under Bothell Way and connecting by PRV to ex. 8" DI on south side Bothell	none			12" and 10" DI will create a redundant supply to Beach Zone.	840	250	$210,000	
OptB-D38.3	Beach Zone West Loop Option "B" - Towne Center west boundary.	Capital Improvement funds and State Loan	Private Easement along west side of LFP Towne Center to #17020 Bothell Way	none	0	$0	12" HDPE by HDD will convey water from Towne Center (north service) to give redundancy and looping for circulation in Beach zone. Also allows service to lots along Bothell Way now served by others.	925	250	$231,250	
OptB-D38.4	Beach Zone West Loop Option "B" - Towne Center west boundary. Share casing with Shoreline WD?	Capital Improvement funds and State Loan	36" Bore with casing under Bothell Way from #17020 to 171st Street #4506 for connection through PRV to existing 8" DI on 171st Street	none	0	$0	10" DI (see project #D38)	415	250	$103,750	
D39	Beach Zone West Loop Option A, B	Capital Improvement funds and State Loan	Option "A" Located at #17124 Beach Dr. acroos from BofA Option "B" Located at 171st Street near 45th Ave. NE	none			Pre-fabricated PRV station 6x2 with 8" reverse check valve bypass, flow meter	1	70000	$70,000	$280,000
D40	Horizon View Service Zone Phase II - Customer Re-capture	Capital Improvement funds and State Loan	189th PL cul-de-sac with tie in on 46th Ave.	8" DI from Horizon View is on 46th Ave.	0		8" DI and 2" HDPE or purchasee ex. W/M from NUD? Plus 11 additional services along 46th Ave Ne.	405	100	$40,500	
D41	Horizon View Service Zone Phase II - Customer Re-capture	Capital Improvement funds and State Loan	Easement from #18920 46th Ave. east to 47th Ave. and southeast on 47th Ave. to 187th PL	currently served by NUD	0		8" DI main pipe (joint restraints throughout)	780	200	$156,000	
D42	Horizon View Service Zone Phase II - Customer Re-capture	Capital Improvement funds and State Loan	Intersection '47th Ave./187th PL to #4904 187th PL	currently served by NUD	0		10" DI main pipe with joint restraints to allow for future connection to Tolt near #4922 187th PL	500	230	$115,000	
D43	Horizon View Service Zone Phase II - Customer Re-capture	Capital Improvement funds and State Loan	Intersection187th PL/49th PL to #18720 49th PL (site of LFPWD "High zone" steel standpipe)	currently served by NUD	0		8" DI main will provide loop to 184th St. (joint restraints throughout)	750	200	$150,000	$461,500
								15621	**Grand Total all projects**		**$3,442,950**

file: Raid2:\system plan\Capital Projects.xls
edit: Oct. 1, 2015

Table 8-3 Capital Improvements 2027 – 2034
\\Raid\raid-2\System Plan Work\Capital Projexts.xls

(g) Intermediate Zone Customer Re-capture from NCWD, Not Budgeted

This project:

- Would construct watermain and services to serve 11 customers
- Total 680 lin-ft 8" transmission main is required, although this is already budgeted under project #D34A (1950 lin-ft 8" DI) which was planned for looping on 185th St.

(h) Low Zone Customer Re-capture from NCWD, Not Budgeted

This project:

- Would construct watermain and services to serve up to 10 customers – mostly on 180th St. (Perkins Way) on the west side of McAleer Creek.
- Total length of watermain not known

PART NINE FINANCIAL PLAN

I. BACKGROUND INFORMATION

The main purpose of Part Nine is to evaluate funding options and to ensure the adequacy of rate revenue and other revenues to meet the projected financial obligations. The analysis projects any adjustments in rates needed to fully fund operating and capital expenses of the utility. After briefly summarizing the District's capital and operating needs, Part Nine analyzes funding options. The chapter also describes the District calculation of Capital Facility Charges, which are based on historical investment in capital infrastructure.

UNIQUE ADVANTAGES OF OWN WATER SOURCE

LFPWD serves a community of primarily single-family dwellings; residents have a history of being environmentally and fiscally conscious and value naturally pure water. The District supplies all water from its own groundwater sources which creates a relative financial advantage compared to other water utilities in the Seattle area. Water production costs from the District's own sources have been estimated at about $200 per MG (Million gallons), compared with about $3,000 per MG if purchased wholesale in the peak summer season. With annual production of 94 MG there is an estimated benefit of about $267,000 per year to the District.

STEEL TRANSMISSION AND DISTRIBUTION PIPING

In spite of the benefit of having a low cost water supply LFPWD customer rates are presently similar to other water utilities in the City of LFP. This is readily understood in view of the large investment in capital improvements being made presently. **Table 9-1** below compares capital improvement plan expenditures (CIP) with other water utilities operating in Lake Forest Park. Data were obtained from a utility study by the City of Lake Forest Park dated April 2015. Data show that over each of the past 4 years the District invested on average over $374 per customer in capital improvements. And this pattern is continuing – current CIP calls for $309 per customer per year over the next 5 years.

Utility	Average Annual CIP (millions)	Average 2015-2019 CIP *per Cust.*	Average 2011 – 2014 Capital Imp. *Per Cust.*
North City Water District	1.66	206	
Northshore Utility District (Water)	1.92	87	
Lake Forest Park Water District	0.27	309	374
Seattle Public Utilities	44.9	227	
Total Water Utilities	**$48.75**	**$ 214**	

Table 9-1 Capital Improvement Investment by Water Utilities in LFP

In the late 1980's the District began replacing major sections of steel pipe which were beginning to fail at an increasing rate. By the late 1990's it became apparent that the cost of infrastructure replacement had to be recovered through several real rate increases (above inflationary cost index) either as base rate, special fixed fees, or water usage rate.

By the new millennium in the face of increasing failures of aging thin wall steel and galvanized iron pipe the District questioned its ability to ever surmount the looming financial obligation of completing the necessary upgrades to the system. Comprehensive Water System Plan 2005 offered a conceivable pathway to complete the required work over 20 years with the help of low interest financing through 20-year PWTF loans. In the past 10 years the District has replaced about 15,000 feet of steel and galvanized iron watermain which is roughly half of the 29,164 feet of replacements called for by 2020 the in the 2005 CWSP. There remain about 12,150 feet of thin wall steel and 3,075 feet of galvanized iron pipe in the network at present.

The Capital Improvement Plan (CIP) in this document (Part Eight) prioritizes replacement of all remaining thin wall steel and galvanized iron pipe over the next 10 years (by 2026). Implementation of the proposed CIP pipe replacements through 2026 is considered critical to avoid the increasing cost of pipe failures. **Figure 9-1** (below) illustrates the rapid increase in failure rate over the years '2000 – '2010. With due consideration for a recent dip in pipe failure rate following several major replacement projects ('2011 – 2014) there remains a high anticipated cost of failures if replacement of the remaining steel pipe is delayed further. Improvements scheduled after 2026, while important, are more to reduce risk and increase revenue base rather than stave off ballooning repair costs and hence are less critical.

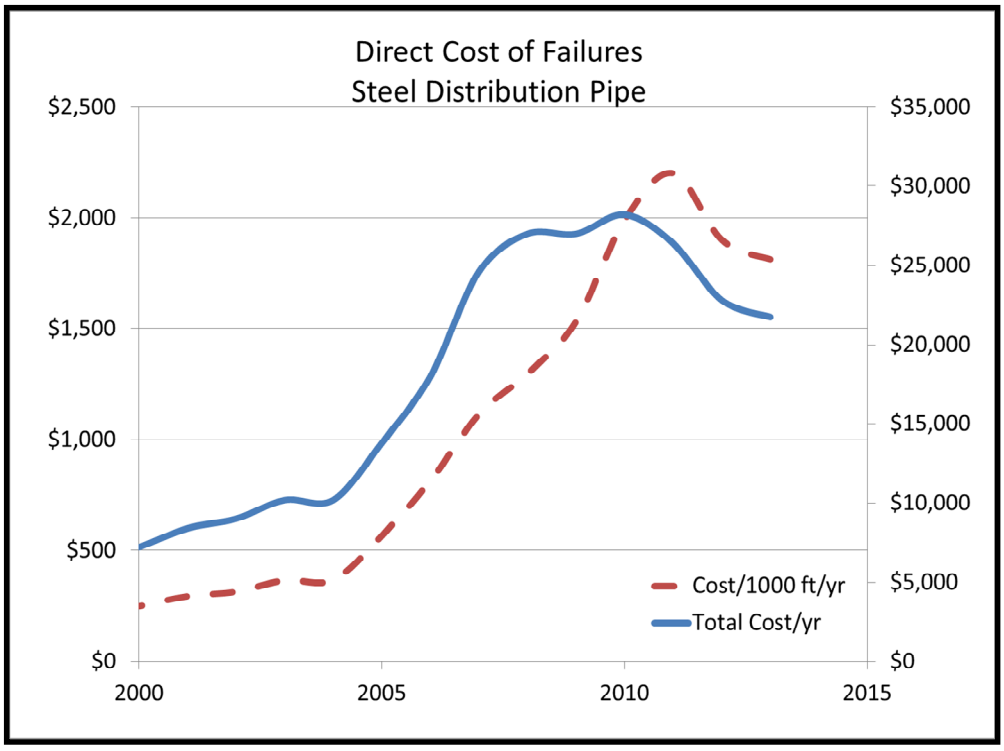


Figure 9-1 Incidence and Direct Cost of Pipe Failures
Raid-2:\Inventory\Leaks.xls

NEW TRANSMISSION AND DISTRIBUTION PIPE - LONGER LIFESPAN

Local soil corrosion testing sample data were applied to the ANSI/AWWA 10-point corrosion formulae. The result (3-points) suggests a plausible lifespan of at least 375 years for ductile iron pipe in the District*. Inquiries were made with manufacturers regarding the expected life of ductile iron pipe gaskets. At this time the available information suggests bell gaskets will have a useful life of greater than 100 years**. HDPE pipe is also believed to have a useful life of at least 100 years.

Figure 9-2 (below) illustrates annual feet of transmission and pipe construction in the District since the 1940's and projects future replacements with the conservative (short life) assumption of a 100-year lifespan for ductile iron and HDPE pipe.

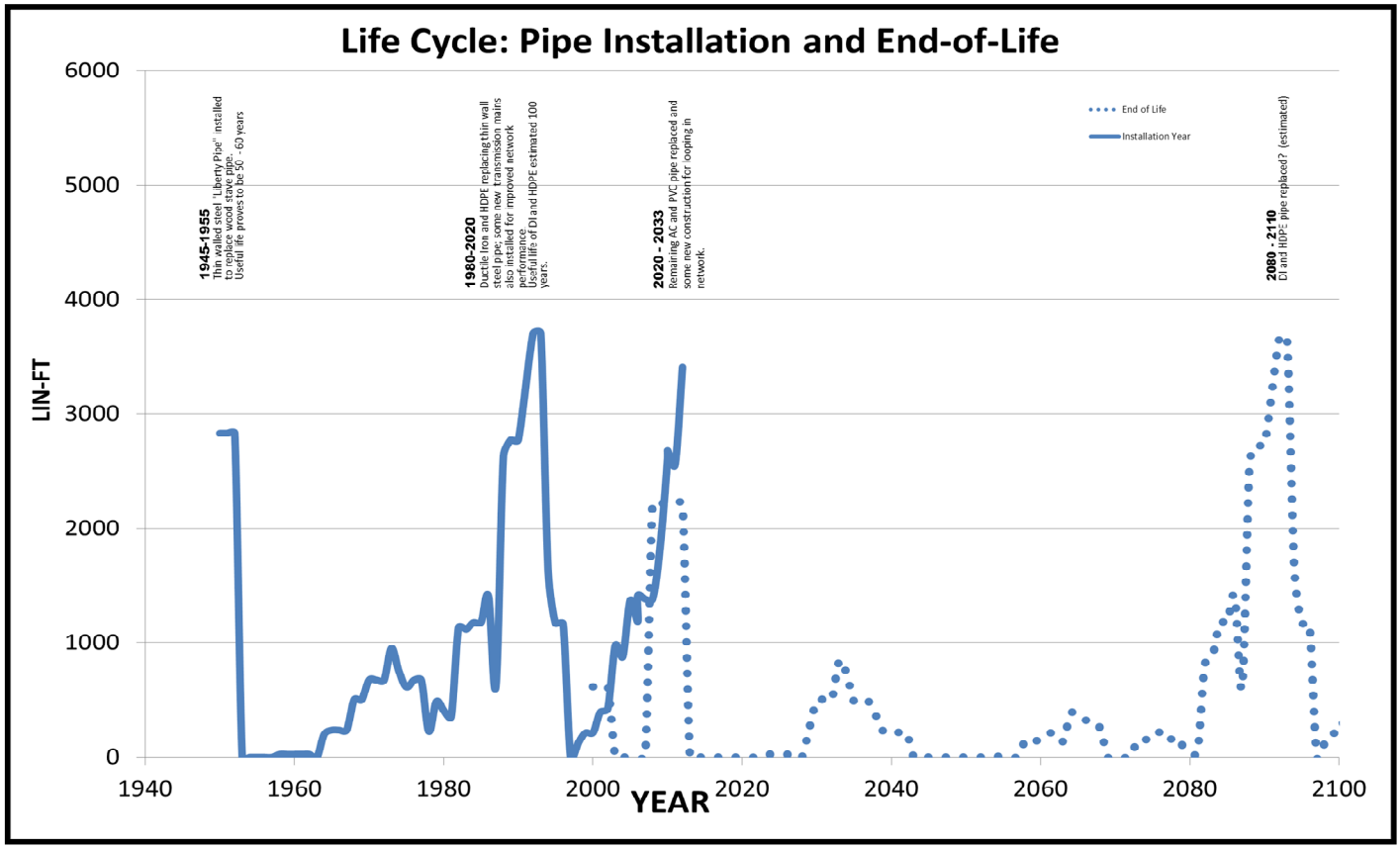


Figure 9-2 Historical and Future Pipe Installation per Year

Raid-2:\Inventory\Pipe Inventory.xls

*soil sample & analysis obtained by Northshore Utility District. Please see Appendix 9-A for details. Predicted lifespan as presented by American Water Works Association "Corrosion and corrosion control of iron pipe: 75 years of research, Journal AWWA June 2005.

** rubber gasket information from Mike Horton, PE US Pipe, Bessemer, AL. Please see Appendix 9-A

II. REVENUE REQUIREMENT ANALYSIS

Revenue for operations and capital improvement obligations in LFPWD (as in most special purpose districts) are generally covered entirely through charges to customers; there are no other revenue streams, such as special taxes or levies to fund these expenditures. Hence there is a practical limit to how the District conducts its operations and capital improvement programs so as to ensure rates remain within reason and comparative affordability while still providing safe water and reliable service. LFPWD has a responsibility to manage its operating costs and the timing of its capital expenditures to ensure that the costs are spread out appropriately over time such that, to the extent possible, today's customers are paying today's costs.

In 2014 the District retained the services of Peninsula Financial Consulting, a utility rate consultant, to carry out a revenue requirements and rate structure review using capital cost projections from the District's Capital Improvement Plan as well as forecasted operations costs. From this work, recommendations on rate levels are derived. With the Peninsula Financial report as a basis the District presents the following analysis.

REVENUE REQUIREMENTS:

Revenue, in the form of customer charges, is needed to cover to three main categories of expenditures: 1) the costs of operating and maintaining the District's facilities to provide current service - sometimes referred to as "O&M Expenses"; 2) the cost of repaying debts incurred in prior periods for upgrade or replacement of infrastructure, referred to as "Debt Service"; and 3) current and future expenditures necessary to replace aging facilities to ensure long-term reliability of service, often referred to as "Capital Expenditures".

Operations and Maintenance Expenses:

Generally, the best method of forecasting ongoing O&M Expenses is to consider the average of such costs over recent years and adjust for inflation and known or predictable changes. Below in **Table 9-2** is a brief summary of recent O&M expenses and the resulting baseline budget that serves as a starting point for a long-term forecast.

Historic Operations and Maintenance Expenses	2011	2012	2103	2014	Baseline Budget
OPERATING EXPENDITURES					
SUBTOTAL 6000 · Administrative Expenses	12,893	17,253	16,341	16,726	17,300
SUBTOTAL 6200 · Maintenance	22,556	23,270	21,320	26,366	23,300
SUBTOTAL Professional Services	187,284	108,915	103,075	183,824	138,100
SUBTOTAL 6400 · Utilities	21,217	19,586	22,271	23,233	23,100
SUBTOTAL 6500 · Payroll & Benefits Expense	187,737	211,360	203,042	218,945	218,900
SUBTOTAL Other Expenses	35,012	42,681	43,518	45,850	48,100
Subtotal O&M	466,698	423,066	409,567	514,943	468,800
SUBTOTAL Tax and Franchise	55,615	58,822	57,168	57,598	59,600
TOTAL O&M EXPENSES	522,313	481,888	466,736	572,540	528,400

Table 9-2 Historic Operations and Maintenance Expenses

LFPWD's Typical Operations and Maintenance expenses are illustrated in **Figure 9-3**.

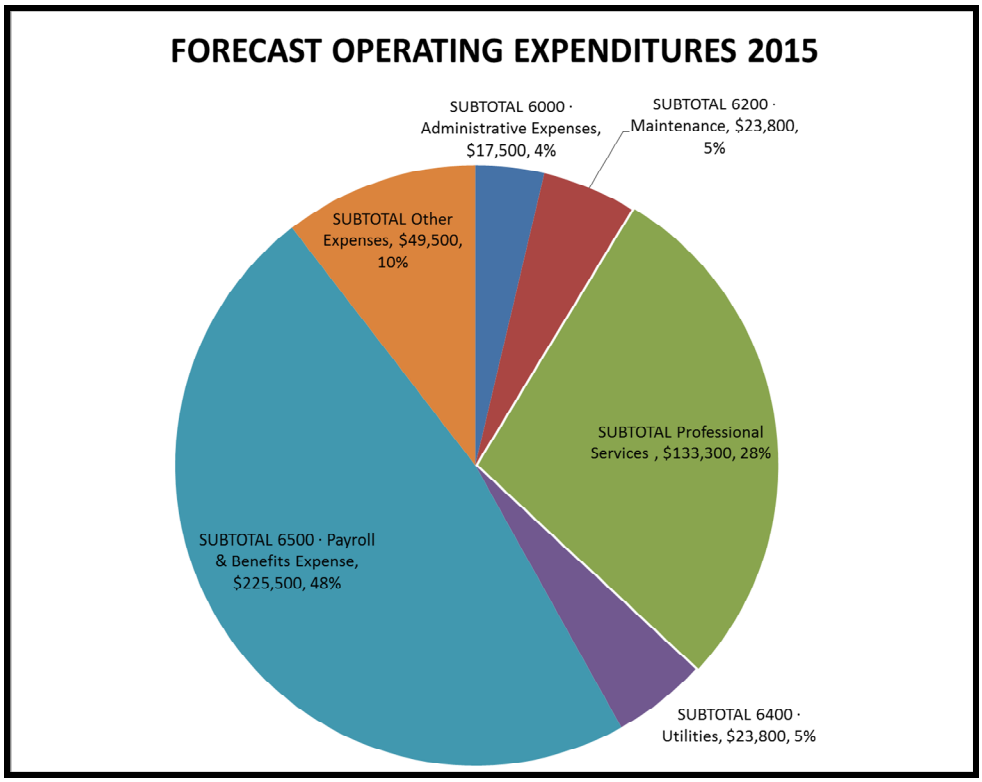


Figure 9-3 Forecast Operations Expenditures

O&M expenses (including tax and franchise fees are forecast for other years in the future, as shown in **Table 9-3** (below).

	2015	2016	2017	2018	2019	2020
OPERATING EXPENDITURES						
SUBTOTAL 6000 · Administrative Expenses	17,500	17,500	17,800	17,900	18,100	18,100
SUBTOTAL 6200 · Maintenance	23,800	24,200	24,800	25,200	25,700	26,300
SUBTOTAL Professional Services	133,300	143,600	138,500	141,400	152,500	147,100
SUBTOTAL 6400 · Utilities	23,800	24,500	25,300	26,000	27,000	27,800
SUBTOTAL 6500 · Payroll & Benefits Expense	225,500	232,300	239,200	246,400	253,700	261,300
SUBTOTAL Other Expenses	49,500	51,000	52,600	54,200	56,000	57,800
Subtotal O&M	473,400	493,100	498,200	511,100	533,000	538,400
SUBTOTAL Tax and Franchise	59,600	59,600	59,600	59,600	59,600	59,600
TOTAL O&M EXPENSES	533,000	552,700	557,800	570,700	592,600	598,000

Table 9-3 Forecast Operations and Maintenance Expenses

Debt Service:

Table 9-4 lists the annual debt repayment costs (principal and interest) for all LFPWD loans outstanding. These amounts represent the financed portion of capital improvements that allocate the costs of such improvements over a portion of their useful lives. Included is a new loan (PC13-961-009) from PWTF that is being used to finance 80% of the costs of Project SS1 (McKinnon Creek Pumphouse) in 2014 through 2016.

	2015	2016	2017	2018	2019	2020
DEBT SERVICE						
PW-01-691-034	**40,500**	**40,300**	**40,100**	**39,900**	**39,700**	**39,500**
PC08-951-022	**55,300**	**55,100**	**54,800**	**54,600**	**54,300**	**54,000**
PC13-961-009	**-**	**3,400**	**17,100**	**34,300**	**34,300**	**34,300**
Total DEBT SERVICE	**95,800**	**98,800**	**112,000**	**128,800**	**128,300**	**127,800**

Table 9-4 Current Debt Service

Capital Expenditures:

Table 9-5 lists capital projects scheduled to occur over the next 6 years. Note that the District has numerous water line rehab projects that for modeling purposes have been equalized over the 6 year planning period under the title "Annual Pipe Replacement Program". Also note that planned capital improvement costs discussed in Chapter 8 are in current day dollars but the numbers shown in **Table 9-5** have been adjusted for 2.0% annual cost inflation.

	2015	2016	2017	2018	2019	2020
CAPITAL EXPENDITURES						
Annual Pipe Replacement Program	200,000	200,000	430,000	430,000	430,000	220,000
SS1 - (District's 20% share)	-	47,200	66,700	-	-	-
SS2 - Retrofits to well #3	-	-	-	-	25,000	-
SS3 - Seismic eval & inspection of coatings	-	-	-	-	-	-
B1 - Covered Equipment Bay at McKinnon Cr.	-	-	-	-	-	27,000
Total CAPITAL EXPENDITURES	**200,000**	**247,200**	**496,700**	**430,000**	**455,000**	**247,000**

Table 9-5 Forecast Capital Expenditures

In order to determine the adequacy of current rates, it is necessary to compare the current revenue stream recovered from customers with the forecasted Operations and Maintenance Expense, Debt Service costs and planned Capital Expenditures.

Revenues:

The District's recent historic revenue is summarized in Table 9-6 below. Water Charge Revenue varies from year to year based on actual customer usage and to a small extent, the timing of customer payments. Capital Improvement Revenue has varied annually due to the addition of customers and the timing of payments. In order to project into the future, a baseline budget has been established.

	2011	2012	2103	2014	Baseline Budget
REVENUES					
0000 - Water Charge Revenue	**507,911**	**536,540**	**520,032**	**546,423**	**541,200**
0000 - State Excise Tax Rev	**25,279**	**26,737**	**25,986**	**26,181**	**27,100**
0000 - City Franchise Fee Rev	**30,335**	**32,085**	**31,183**	**31,417**	**32,500**
OPERATING REVENUES	**563,525**	**595,362**	**577,201**	**604,020**	**600,800**
4120 · Capital Improvement Revenue	**93,647**	**97,610**	**95,779**	**96,002**	**97,700**
0000 - Misc.Capital Revenue	**18,718**	**16,613**	**8,505**	**5,892**	**0**
CAPITAL REVENUES	**112,365**	**114,223**	**104,284**	**101,894**	**97,700**
TOTAL REVENUES	**675,891**	**709,585**	**681,485**	**705,914**	**698,500**

Table 9-6 Historic Revenue

Projected Results Using Current Rates:

Table 9-7 compares projected revenue at current rates, with previously secured, but as yet unused-loan funds with projected operations and maintenance expenses, debt service on existing loans and planned capital expenditures. In order to facilitate analysis of rate adjustment scenarios the District's finances are accounted for in an Operations Fund and a Capital Fund.

	2015	2016	2017	2018	2019	2020
OPERATIONAL SUMMARY						
(+) Total Operating Revenues	600,800	600,800	600,800	600,800	600,800	600,800
(-) Total Operation & Maintenance Expense	(473,400)	(493,100)	(498,200)	(511,100)	(533,000)	(538,400)
(-) Total Tax and Franchise Expense	(59,600)	(59,600)	(59,600)	(59,600)	(59,600)	(59,600)
(+/-) Transfer from/(to) Capital	(67,800)	(48,100)	(43,000)	(30,100)	(8,200)	(2,800)
NET OPERATIONS REVENUE	-	-	-	-	-	-
CAPITAL SUMMARY						
Start of Year Capital Fund	227,000	304,000	312,600	(152,600)	(596,700)	(1,103,900)
(+) Capital Improvement Revenue	97,700	97,700	97,700	97,700	97,700	97,700
(+) Interest Income on Cash Reserves	9,300	10,800	2,800	(13,100)	(29,800)	(44,200)
(+) New Loan Funds	198,000	198,000	-	-	-	-
(-) Existing Debt Repayments	(95,800)	(98,800)	(112,000)	(128,800)	(128,300)	(127,800)
(-) New Debt Repayments						
(-) Total Capital Expenditures	(200,000)	(247,200)	(496,700)	(430,000)	(455,000)	(247,000)
(+/-) Transfer from/(to) Operations	67,800	48,100	43,000	30,100	8,200	2,800
NET CAPITAL REVENUE	77,000	8,600	(465,200)	(444,100)	(507,200)	(318,500)
End of Year Capital Fund	304,000	312,600	(152,600)	(596,700)	(1,103,900)	(1,422,400)

Table 9-7 Revenue Requirement Analysis with Current Rates

*As demonstrated in **Table 9-7** Operating Revenues under current rates are adequate to cover projected operating expenses and provide a small contribution to the capital fund at least for several years. However, in order to adequately fund capital expenditures and maintain a capital reserve, over $1.4 Million* in additional loans and or Capital Improvement Fund Revenue are necessary over the next 6 years.*

*

Additional Debt Financing:

Table 9-8 adds the expected availability of low interest municipal debt of the type obtained from the PWTF or similar sources (or through issuance of bonds by the District) into the analysis. Additional debt financing will require additional debt service costs. The use of debt financing of this type aids in spreading the costs of the capital expenditures over time, more closely matching the life of the improvements. Table 9-8 demonstrates that while the assumed new debt significantly closes the capital funding gap, within 6 years the District's Capital Reserve would be completely depleted. Many debt funding sources will require the District to maintain an adequate cash capital reserve to provide security of repayment, so depletion of the Capital Reserve is not an acceptable long-term option.

	2015	2016	2017	2018	2019	2020
OPERATIONAL SUMMARY						
(+) Total Operating Revenues	600,800	600,800	600,800	600,800	600,800	600,800
(-) Total Operation & Maintenance Expense	(473,400)	(493,100)	(498,200)	(511,100)	(533,000)	(538,400)
(-) Total Tax and Franchise Expense	(59,600)	(59,600)	(59,600)	(59,600)	(59,600)	(59,600)
(+/-) Transfer from/(to) Capital	(67,800)	(48,100)	(43,000)	(30,100)	(8,200)	(2,800)
NET OPERATIONS REVENUE	-	-	-	-	-	-
CAPITAL SUMMARY						
Start of Year Capital Fund	227,000	304,000	300,900	245,100	199,700	80,200
(+) Capital Improvement Revenue	97,700	97,700	97,700	97,700	97,700	97,700
(+) Interest Income on Cash Reserves	9,300	10,600	9,600	7,800	4,900	100
(+) New Loan Funds	198,000	198,000	425,700	425,700	425,700	217,800
(-) Existing Debt Repayments	(95,800)	(98,800)	(112,000)	(128,800)	(128,300)	(127,800)
(-) New Debt Repayments	-	(11,500)	(23,100)	(47,900)	(72,700)	(97,500)
(-) Total Capital Expenditures	(200,000)	(247,200)	(496,700)	(430,000)	(455,000)	(247,000)
(+/-) Transfer from/(to) Operations	67,800	48,100	43,000	30,100	8,200	2,800
NET CAPITAL REVENUE	77,000	(3,100)	(55,800)	(45,400)	(119,500)	(153,900)
End of Year Capital Fund	304,000	300,900	245,100	199,700	80,200	(73,700)

Table 9-8 Revenue Requirement Analysis with Current Rates and additional Debt

Additional Capital Improvement Fund and Operating revenue

In conclusion, the District must raise revenue from capital improvement fees by increasing the Capital Improvement Fund (CIF) rate. The District will consider options to increase the CIF rate to generate adequate funding (along with securing additional debt) to align the timing of the revenue collected with the timing of capital improvements

Table 9-9 (below) demonstrates the financial impact of a $3.00 increase in the monthly CIF rate effective January 1, 2016 as approved by the LFPWD Board of Commissioners in Resolution No. 360 on December 16, 2015. The table also demonstrates:

- A $2.00 increase in the CIF charge each subsequent January 1, although such increases have not yet been approved by the LFPWD Board.
- The establishment of an Operations Reserve fund, designed to ensure adequate cash on hand for expenses early in each year, prior to the normally higher summer revenues.
- Annual increases of 1.75% in rates for operating revenues (combination of Base rate and Water Use charge) beginning January 2018, to ensure timely recovery of increased operating costs.
- A correction in the calculation of Interest Income and Interest Expense.
- The addition of an estimate of the maximum annual impact of the demonstrated rate increases as would impact the lowest volume water users. (The percentage impact would be lower on higher volume users, because the increase in operating revenue related volumetric rates are lower than the increase in capital funding related fixed charge rates.)

	2015	2016	2017	2018	2019	2020
OPERATIONS SUMMARY						
Start of Year Operations Fund	-	-	25,000	25,000	30,000	30,000
(+) Total Operating Revenues *	600,800	600,800	600,800	610,700	620,900	631,100
(-) Total Operation & Maintenance Expense	(473,400)	(493,100)	(498,200)	(511,100)	(533,000)	(538,400)
(-) Total Tax and Franchise Expense	(59,600)	(59,600)	(59,600)	(60,500)	(61,600)	(62,500)
NET OPERATIONS REVENUE	67,800	48,100	43,000	39,100	26,300	30,200
(+/-) Transfer from/(to) Capital	(67,800)	(23,100)	(43,000)	(34,100)	(26,300)	(30,200)
End of Year Operations Fund	-	25,000	25,000	30,000	30,000	30,000
CAPITAL SUMMARY						
Start of Year Capital Fund	227,000	297,500	299,100	298,500	338,500	346,300
(+) Capital Improvement Revenue *	97,700	134,300	158,800	183,200	207,600	232,000
(+) Interest Income on Cash Reserves	2,800	3,700	3,700	3,700	4,200	4,300
(+) New Loan Funds	198,000	198,000	425,700	425,700	425,700	217,800
(-) Existing Debt Repayments	(95,800)	(98,800)	(112,000)	(128,800)	(128,300)	(127,800)
(-) New Debt Repayments (incl.Interest)	-	(11,500)	(23,100)	(47,900)	(72,700)	(97,500)
(-) Planned Capital Expenditures	(200,000)	(247,200)	(496,700)	(430,000)	(455,000)	(247,000)
NET CAPITAL REVENUE	2,700	(21,500)	(43,600)	5,900	(18,500)	(18,200)
(+/-) Transfer from/(to) Operations	67,800	23,100	43,000	34,100	26,300	30,200
End of Year Capital Fund	297,500	299,100	298,500	338,500	346,300	358,300
Maximum Annual Customer Bill Increase *		5.9%	3.7%	4.9%	4.7%	4.5%
*** table reflects some rate increases not yet approved by the Board of Commissioners**						

Table 9-9 Revenue Requirement Analysis with additional Debt and increased CIF rate

The impact of the additional capital improvement funds satisfies the objectives of funding the minimum capital replacement plan (Part Eight) and maintains adequate reserve requirements that are anticipated to be necessary to obtain debt financing.

Projected Results 2015 Through 2020

The District may consider other methods of increasing the CIF rate in order to recover costs of planned infrastructure projects and to maintain an adequate Capital Reserve to help ensure availability of financing options. Any such change in rates will be considered in the light of then current developments and proposed and discussed in an open meeting of the Board of Commissioners and passed by Resolution. Tables 9-9 and 9-10 and Figure 9-4 demonstrate assumed future increases in the CIF rate, the Base rate and the Water Usage rate.

As previously indicated only increases in the CIF rate are anticipated in the near term. The District will consider changes to Base and/or Water Use rates to address the impact of inflation, major changes in Operating and Maintenance expenses and the establishment of an Operations Reserve in the future. Restricting the Board approved increase to the Capital Improvement Fund rate in the near-term is appropriate because the need for increased revenue is to fund on-going capital improvements.

Projected Results Through 2034

A 20 year forecast of revenue requirements is illustrated in Table 9-10 and Figure 9-4. The 20 year forecast is an extension of the 6 year forecast in Table 9-9 and uses the same cost inflators and planned capital projects. Similar to the 6 year forecast, future pipe replacement projects have been normalized over the remaining years and reported as average annual pipe replacement program expenditure. Any forecast of this length should be viewed as an estimate, because assumed cost inflators and the timing of specific projects can vary due to unforeseen circumstances.

The 20 year forecast assumes continued gradual increases in the CIF rate, Base rate and Water Usage rate as necessary to achieve prudent operating and capital reserves. The District has assumed that declining use per customer will offset the small projected increase in customer count.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
OPERATIONS SUMMARY										
Start of Year Operations Fund	-	-	25,000	25,000	30,000	30,000	30,000	30,000	30,000	40,000
(+) Total Operating Revenues *	600,800	600,800	600,800	610,700	620,900	631,100	652,930	652,400	667,900	683,900
(-) Total Operation & Maintenance Expense	(473,400)	(493,100)	(498,200)	(511,100)	(533,000)	(538,400)	(552,600)	(576,100)	(582,300)	(597,500)
(-) Total Tax and Franchise Expense	(59,600)	(59,600)	(59,600)	(60,500)	(61,600)	(62,500)	(63,600)	(64,700)	(66,200)	(67,800)
NET OPERATIONS REVENUE	67,800	48,100	43,000	39,100	26,300	30,200	36,730	11,600	19,400	18,600
(+/-) Transfer from/(to) Capital	(67,800)	(23,100)	(43,000)	(34,100)	(26,300)	(30,200)	(36,730)	(11,600)	(9,400)	(18,600)
End of Year Operations Fund	-	25,000	25,000	30,000	30,000	30,000	30,000	30,000	40,000	40,000
CAPITAL SUMMARY										
Start of Year Capital Fund	227,000	297,500	299,100	298,500	338,500	346,300	358,300	396,830	377,130	424,630
(+) Capital Improvement Revenue *	97,700	134,300	158,800	183,200	207,600	232,000	244,300	256,500	268,700	274,800
(+) Interest Income on Cash Reserves	2,800	3,700	3,700	3,700	4,200	4,300	4,500	5,000	4,700	5,300
(+) New Loan Funds	198,000	198,000	425,700	425,700	425,700	217,800	217,800	217,800	217,800	217,800
(-) Existing Debt Repayments	(95,800)	(98,800)	(112,000)	(128,800)	(128,300)	(127,800)	(127,400)	(87,800)	(87,600)	(87,300)
(-) New Debt Repayments (incl.Interest)	-	(11,500)	(23,100)	(47,900)	(72,700)	(97,500)	(110,100)	(122,800)	(135,500)	(148,200)
(-) Planned Capital Expenditures	(200,000)	(247,200)	(496,700)	(430,000)	(455,000)	(247,000)	(227,300)	(300,000)	(230,000)	(270,000)
NET CAPITAL REVENUE	2,700	(21,500)	(43,600)	5,900	(18,500)	(18,200)	1,800	(31,300)	38,100	(7,600)
(+/-) Transfer from/(to) Operations	67,800	23,100	43,000	34,100	26,300	30,200	36,730	11,600	9,400	18,600
End of Year Capital Fund	297,500	299,100	298,500	338,500	346,300	358,300	396,830	377,130	424,630	435,630
Maximum Annual Customer Bill Increase *		5.9%	3.7%	4.9%	4.7%	4.5%	2.8%	2.7%	3.2%	2.4%
*** table reflects some rate increases not yet approved by the Board of Commissioners**										

Table 9-10 Revenue Requirement Analysis 20 year (cont. next page)

	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
OPERATIONS SUMMARY										
Start of Year Operations Fund	40,000	40,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
(+) Total Operating Revenues *	700,100	717,000	734,200	751,700	769,700	788,100	810,800	834,300	858,400	883,200
(-) Total Operation & Maintenance Expense	(622,600)	(630,300)	(647,100)	(674,300)	(682,100)	(700,500)	(729,800)	(738,700)	(759,000)	(790,700)
(-) Total Tax and Franchise Expense	(69,300)	(71,100)	(72,800)	(74,500)	(76,300)	(78,100)	(80,300)	(82,700)	(85,100)	(87,500)
NET OPERATIONS REVENUE	8,200	15,600	14,300	2,900	11,300	9,500	700	12,900	14,300	5,000
(+/-) Transfer from/(to) Capital	(8,200)	(5,600)	(14,300)	(2,900)	(11,300)	(9,500)	(700)	(12,900)	(14,300)	(5,000)
End of Year Operations Fund	40,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
CAPITAL SUMMARY										
Start of Year Capital Fund	435,630	479,930	512,430	530,430	513,430	532,730	538,730	533,430	562,530	584,630
(+) Capital Improvement Revenue *	280,900	287,000	296,200	305,300	314,500	335,800	366,400	390,800	415,200	439,700
(+) Interest Income on Cash Reserves	5,400	6,000	6,400	6,600	6,400	6,700	6,700	6,700	7,000	7,300
(+) New Loan Funds	217,800	568,300	568,300	568,300	568,300	568,300	568,300	568,300	568,300	568,300
(-) Existing Debt Repayments	(87,100)	(86,800)	(86,500)	(86,300)	(34,300)	(34,300)	(34,300)	(3,400)	(3,400)	-
(-) New Debt Repayments (incl.Interest)	(160,900)	(173,600)	(206,700)	(239,800)	(272,900)	(306,000)	(339,100)	(372,200)	(405,300)	(438,400)
(-) Planned Capital Expenditures	(220,000)	(574,000)	(574,000)	(574,000)	(574,000)	(574,000)	(574,000)	(574,000)	(574,000)	(574,000)
NET CAPITAL REVENUE	36,100	26,900	3,700	(19,900)	8,000	(3,500)	(6,000)	16,200	7,800	2,900
(+/-) Transfer from/(to) Operations	8,200	5,600	14,300	2,900	11,300	9,500	700	12,900	14,300	5,000
End of Year Capital Fund	479,930	512,430	530,430	513,430	532,730	538,730	533,430	562,530	584,630	592,530
Maximum Annual Customer Bill Increase *	2.4%	2.4%	2.7%	2.7%	2.7%	3.9%	5.0%	4.2%	4.1%	4.0%
*** table reflects some rate increases not yet approved by the Board of Commissioners**										

Table 9-10 Revenue Requirement Analysis 20 year (cont. from previous page)

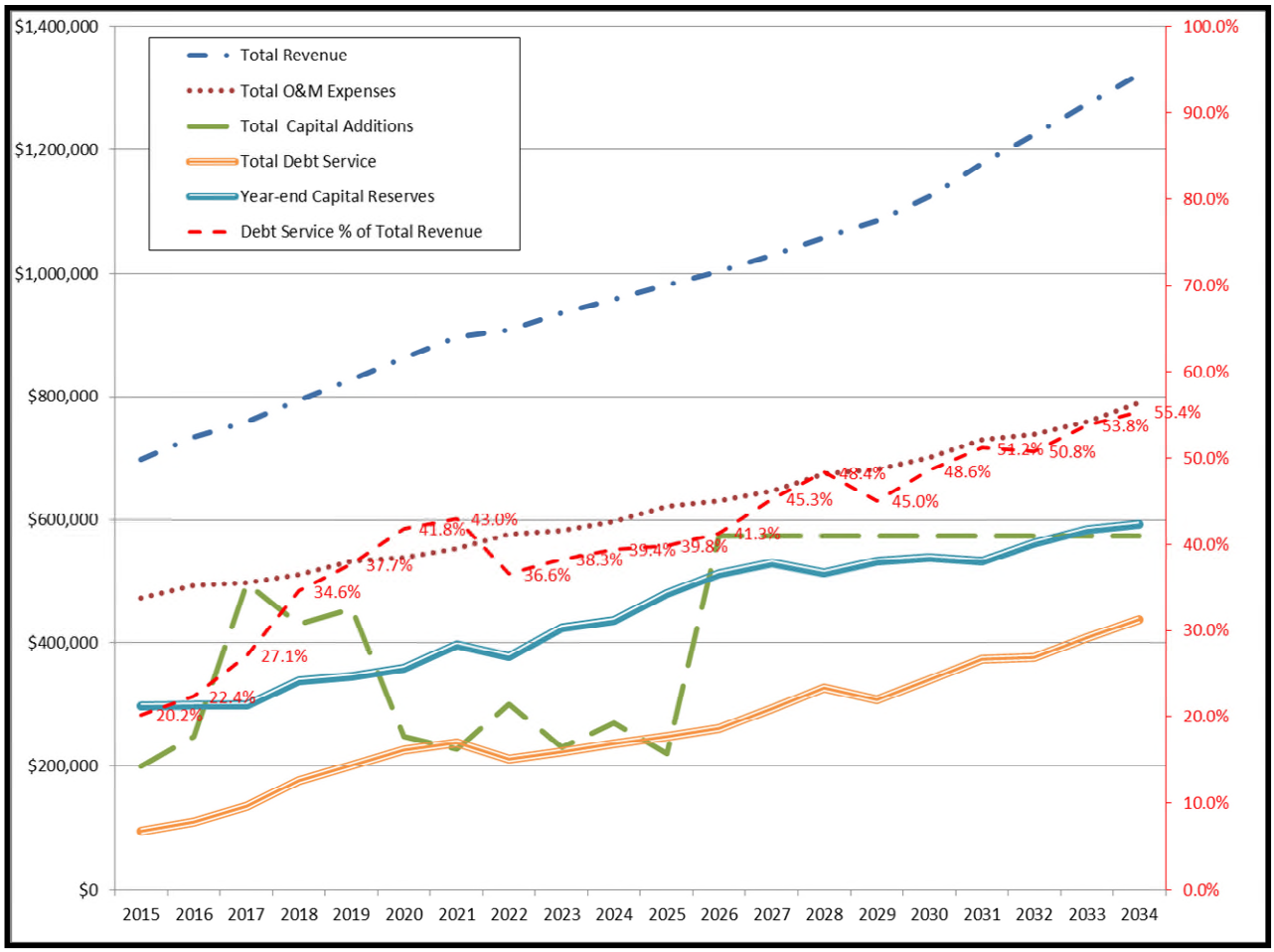


Figure 9-4 Revenue-Expense Projections through 2034

CURRENT WATER RATE STRUCTURE REVIEW

The District's current water rates include the following elements:

- **Base fee** that increases with meter size as shown in **Table 9-11**. This charge is intended to recover the fixed costs of operating and maintaining the facilities of the District used to provide reliable service to customers. The rate increases by meter size to reflect the larger relative size of upstream facilities necessary to support the volumes that can be demanded through the larger meter.
- **Volume rate** applied to all water usage of $3.00 per hundred cubic feet (ccf) which is about 748 gallons. This charge is intended to recover other operations and maintenance costs, that are not recovered through the Base fee, including those that vary by volumes used.
- **Capital improvement fee** which is currently $8.00/month for residential users. Commercial users are apportioned a Capital Improvement Fee with a multiplier that is based on actual usage history compared with the average Equivalent Residential Unit (ERU). **Appendix 9-C** summarizes the apportioned Capital Improvement Fee ERU multiplier for each commercial account based on usage between 12/29/2006 and 12/31/2012. These calculations will be updated periodically to update with more current usage history.
- **Washington State excise tax** of 5.029% is collected and remitted to the State of Washington.
- **LFP City Franchise Fee** of 6.0% is added to water revenue, collected and remitted to the City for use in the City of LFP General Fund.

DESCRIPTION	BI-MONTHLY CHARGE
3/4 INCH METER	$37.00
1 INCH METER	$68.00
3/4 INCH METER -- EXTRA SERVICE	$23.76
I INCH METER -- EXTRA SERVICE	$23.76
1-1/2 INCH METER	$138.00
2 INCH METER	$367.00
3 INCH METER	$729.00
4 INCH METER	$1,132.00
LOW FLOW 6 INCH METER	$2,259.00
8 INCH METER	$3,611.00
LOW FLOW 8 INCH METER	$3,611.00
WHOLESALE RATE	80 % RETAIL

Table 9-11 Base Fee by Meter Size

A typical single family water user's average monthly bill assuming 8 ccf of water use a month (800 cubic feet of water) is $50.50 per month (before taxes). Therefore 53% (($18,50 + $8.00)/$50.50) of a typical residential user's monthly bill is fixed and 47% is due to water usage ((8 ccf x $3.00/ccf)/$50.50).

Some observations:

- Revenue from a typical residential customer is nearly 50% from volumetric revenues - based on usage. However, the vast majority of the District's costs are fixed and do not vary by volume of water used. (The only measureable cost that varies based on usage is the cost of electricity used to pump water from wells to reservoirs and that cost is less than 3% of operating expenses.) The District could consider increasing the Base Fee and decreasing the Water Usage charge, given this relationship. The District has not chosen to adjust this rate structure yet may address this in the future with consideration of customer impacts and conservation.

- Annual Capital Improvement revenue (approximately $98,000) are well below the amount necessary to fund projected capital improvement costs identified in Part Eight. Even if the District were to use 20 year infrastructure loans the CIF revenue is insufficient for the needs of the District. The District should implement an adjustment to the Capital Improvement Fee, along with external financing as necessary to fund the projected capital expenditures.

BASE RATE

Base rates for customers with larger meters could be revised so as to conform with prevailing standards as used by other water utilities. A common industry practice is to use American Water Works Association (AWWA) flow data for larger meters to scale the base rate for larger meters.

Table 9-12 shows the existing ratio of base rates for meters larger than the standard ¾" water meter and the ratios and resulting base rates using AWWA meter factors assuming both a 5/8"x3/4" and ¾" water meter as the base meter size. Based on current customer meter data if the District elected to use AWWA meter factors and set the base size as ¾" the total annual Base Rate revenues would decrease by about $17,000 a year and if the standard size is assumed to be 5/8"x3/4" then there would be a total annual Base Rate revenue increase of about $5,000. However, the District has elected to retain the current Base Rate structure, which allocates additional costs to larger meters, because such meters are typically associated with the types of customer that requires higher fire flow protection thus causing the incurrence of larger upstream infrastructure.

Meter Size	Bi-Monthly Rate	Exist Ratios	AWWA MEQs using 3/4" as Base	Bi-Monthly Rate	AWWA MEQs using 5/8"x3/4" as Base	Bi-Monthly Rate
3/4"	$ 37.00	1.00	1.00	$ 37.00	1.00	$ 37.00
1"	$ 68.00	1.84	1.67	$ 61.79	2.50	$ 92.50
1.5"	$ 138.00	3.73	3.33	$ 123.21	5.00	$ 185.00
2"	$ 367.00	9.92	5.33	$ 197.21	8.00	$ 296.00
3"	$ 729.00	19.70	10.66	$ 394.42	16.00	$ 592.00
4"	$ 1,132.00	30.59	16.66	$ 616.42	25.00	$ 925.00
8"	$ 3,611.00	97.59	53.33	$ 1,973.21	80.00	$ 2,960.00

Table 9-12 AWWA Meter Factors

With monthly capital fee increases as shown in **Table 9-9** the District will generate sufficient revenue to offset increased debt payments needed to pay for planned capital and stabilize cash reserve balances throughout the next 6 years. Therefore the total operating revenues listed in **Table 9-9** are the defined revenue requirements for the District.

FINANCIAL VIABILITY

The most important indicator of financial soundness is positive net revenue from operations and the District is currently meeting this test. The second most important financial test is the level of capital reserves and the District's reserves are not optimal and may be deficient to allow the District to utilize certain debt funding. The District currently has about $200k in cash reserves. Washington State Department of health recommends the following reserve minimums for water providers*:

Reserve Account	WSDOH Recommendation	LFPWD Required	Notes
Cash Reserve	"30 – 45 days of water system costs"	$62,000	Equal to 45/365 days annual operating budget
Emergency Reserve	"enough funds to replace most vulnerable part of the water system"	$50,000	McKinnon DW#1 is arguably "most vulnerable" although a distribution reservoir or watermain would also be vulnerable to earthquake damage. Note that the District has redundancy in sources and there are options for storage. A major transmission main break could also cost around $50,000 to repair.
Capital Improvement Reserve	"savings to ensure that aging equipment and infrastructure do not become a financial burden"	$121,000	Annual debt servicing cost in 2015 for loans used to fund capital improvement projects.
TOTAL RESERVE REQUIRED		**$233,000**	

*Financial Viability for Small Water Systems, Aug., 2013 DOH #331-405

Presently the District is facing significant capital costs associated with the rehabilitation of the existing piping system. The District's engineers have carefully analyzed repair costs versus replacement costs and concluded that due to the condition of some existing piping it is more cost effective to undertake a major program of pipe replacement rather than incurring repair costs that will continue to escalate. Long-term system reliability would suggest such a replacement program as well.

The difficulty for the District is how to fund the extensive pipe replacement costs. Since the District has insufficient reserves the only remaining funding mechanism is debt financing if the planned capital improvements are to occur as scheduled. In point of fact, short of a major delay of several years there is no other option than debt funding. As recommended in this report, the most effective tool for generating the funding to pay for new debt is the capital improvement fee because it places the District in a position to obtain debt financing. The District must build and maintain sufficient reserves through collection of CIF. Further the District will need local CIF matching funds to apply for grant or low interest loan funding. For this reason both the 6 and 20 year forecasts utilize the capital improvement fee to pay for all new debt costs. Revenues from capital improvement fees should never exceed the greater of either annual depreciation or annual debt payments. If these revenues do exceed this limit the excess should be transferred into capital reserves and not used to pay annual operating expenses.

Even though the District has limited potential for new customer growth, there is the possibility of an existing customer property being converted from an existing commercial or residential to a multi-family use. Water agencies are allowed to charge a new connection fee (less the original fee paid) when a customer changes their type of usage or increases the meter size. Multi-family structures often translate into large connection charges due to the high number of units per connection. Therefore the District should regularly update their connection fees with special care given to non-residential connections and ensure that appropriate connection fees are in place well in advance of when such a new customer wishes to connect to the system. Further discussion of connection charges appears in Part Nine, Section VI.

III. RATE COMPARISON WITH REGIONAL COST OF LIVING

Figure 9-5 below compares the trend of LFPWD historical rates (as median residential ¾" service size) since 1974 and Seattle CPI (Consumer Price Index) since 1970. These data show a close correlation between a typical ¾" bi-monthly bill and Seattle CPI excepting for the years 1997 – 2000 where several rate increases were needed to provide adequate revenue for debt servicing and direct funding obligations of ongoing infrastructure replacement and upgrade projects. In this chart the CPI values are forward projected and correlate to a typical bi-monthly bill of around $100.00 in 2015 – in line with current rates.

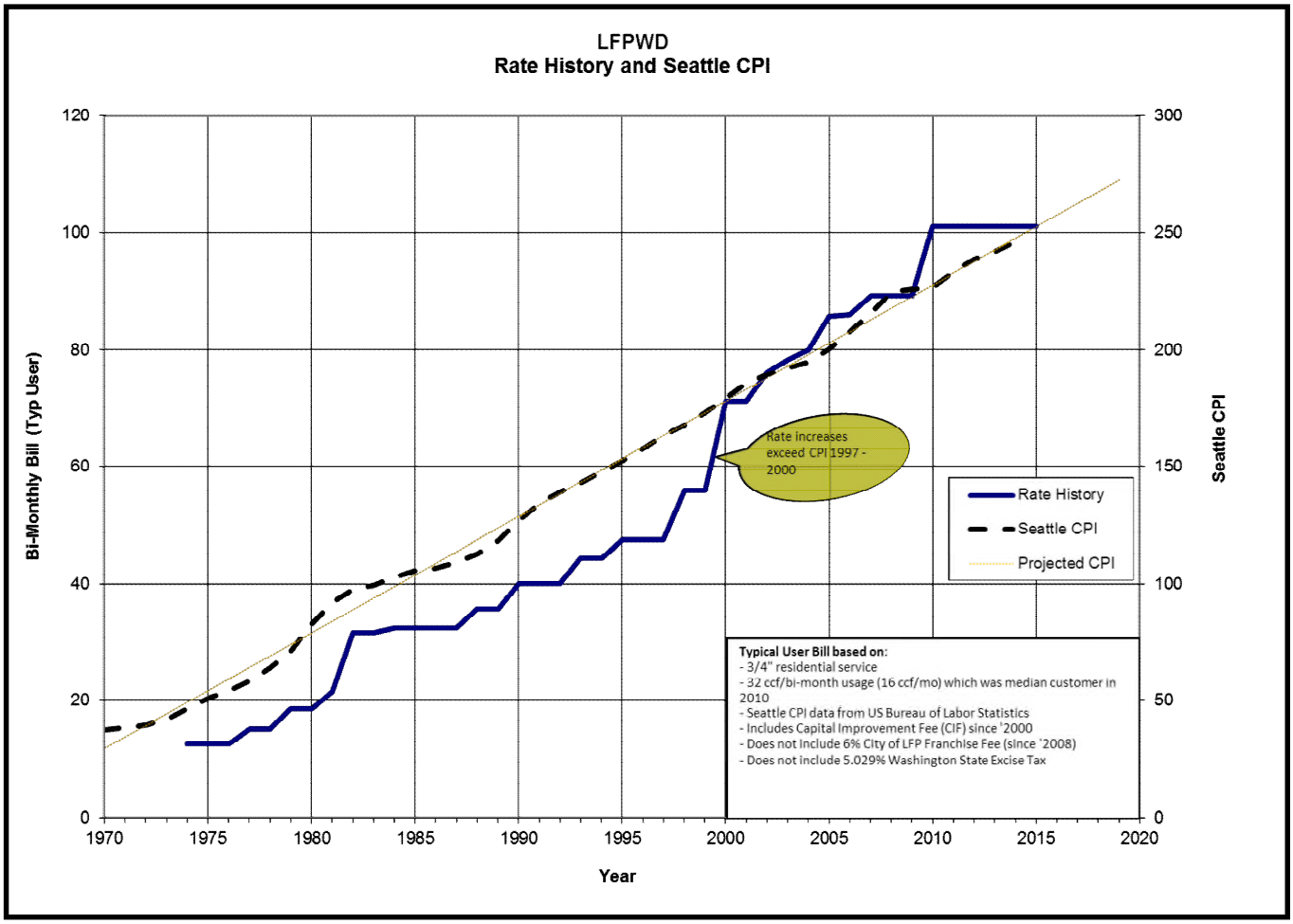


Figure 9-5 Rate History and Seattle CPI

Raid-1\Rates\Rate_History.xls

Figure 9-6 below compares LFPWD historical rates (as median residential ¾" service size) since 1974 and Washington State PCE (Personal Consumption Expenditures) over the years 1997 - 2012. These data show a close correlation between a typical ¾" bi-monthly bill and Washington State PCE excepting for the years 1997 – 2000 where several rate increases were needed to provide adequate revenue for debt servicing and direct funding obligations of ongoing infrastructure replacement and upgrade projects. PCE values are forward projected and correlate to a typical bi-monthly bill of around $120.00 in 2015 – about 20% above current rates.

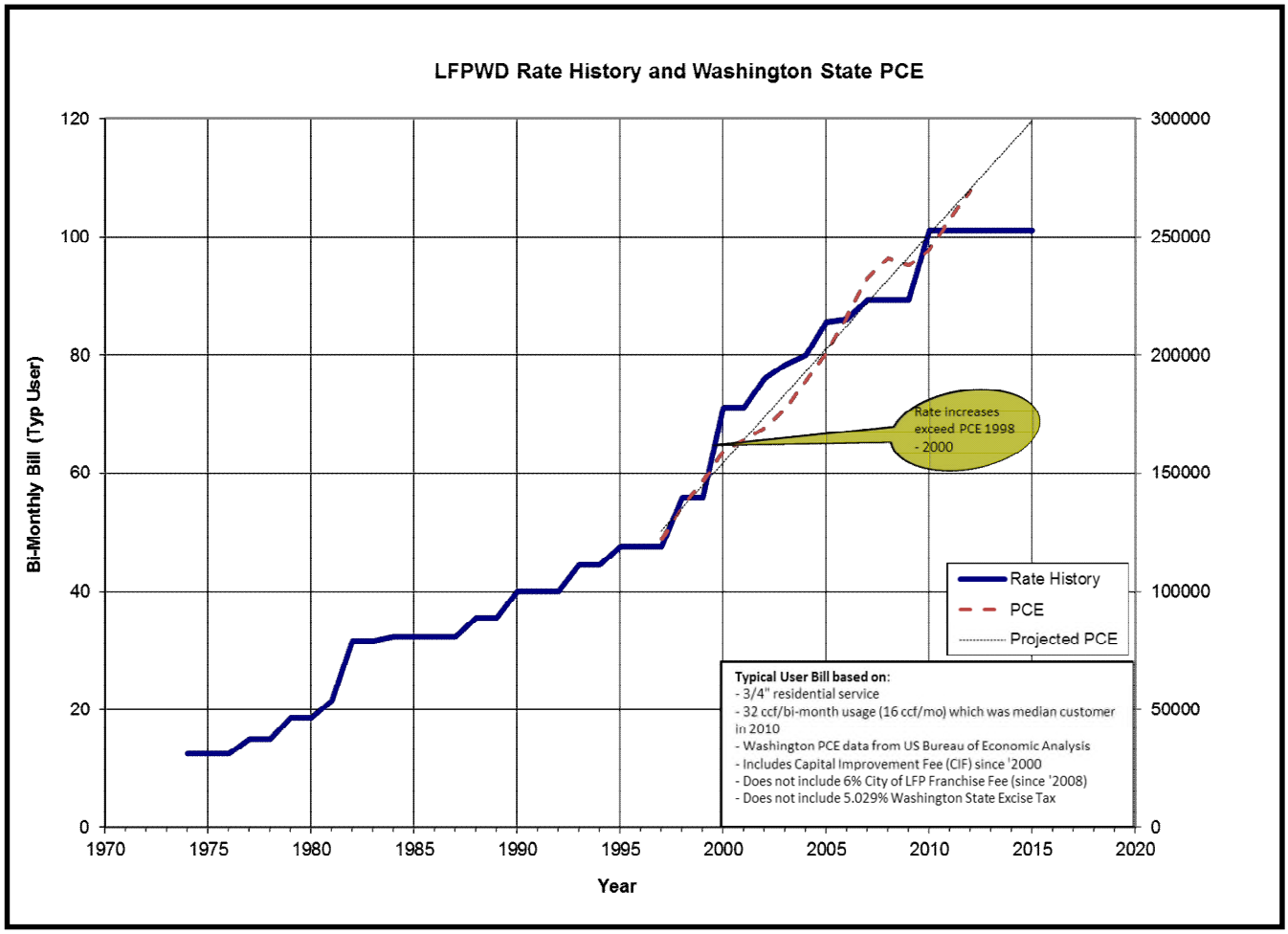


Figure 9-6 Rate History and Washington PCE

Raid-1\Rates\Rate_History.xls

IV. RATE COMPARISON WITH WATER UTILITIES IN REGION

Table 9-13 below is taken from the most recent SPU Annual Survey of Wholesale Customers (2014) which compared customer bills at several consumption rates with those of nearby utilities that are wholesale customers of SPU. These data show that the District rate structure has relatively higher base rate but lower usage rates when compared with surrounding utilities.

Residential Bills Compared with other Utilities (SPU Purveyor Rate Survey 2014)	
"Low" usage (4 ccf/mo Winter and 6 ccf Summer)	Rank #2 of 27 (top 7 percent)
"Medium" usage (8 ccf/mo Winter and 12 ccf Summer)	Rank #4 of 27 (top 15 percent)
"High" usage (16 ccf/mo Winter and 24 ccf Summer)	Rank #14 of 27 (top 52 percent)

Table 9-13 Residential Bills Compared with other Utilities

Figures 9-7, 9-8 and **9-9** (below) are excerpted from the 2014 SPU rate survey and illustrate the survey findings summarize the data in **Table 9-13** with greater detail.

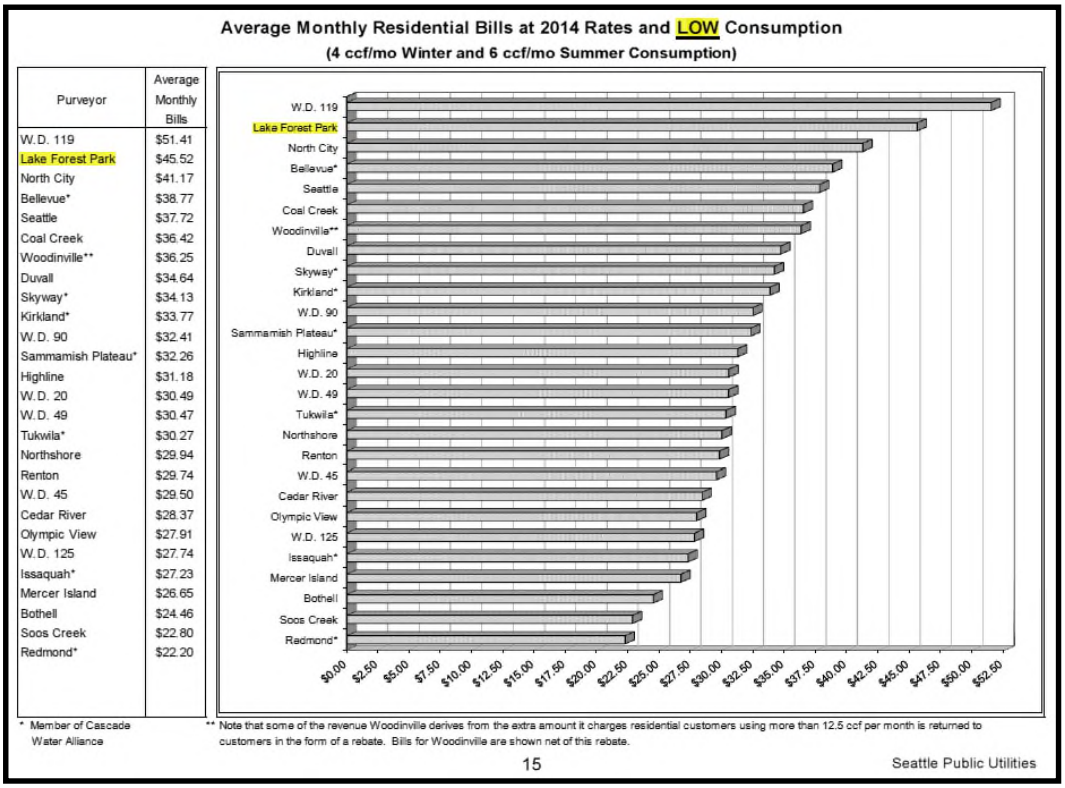


Figure 9-7 Residential Bills Compared: Low Consumption

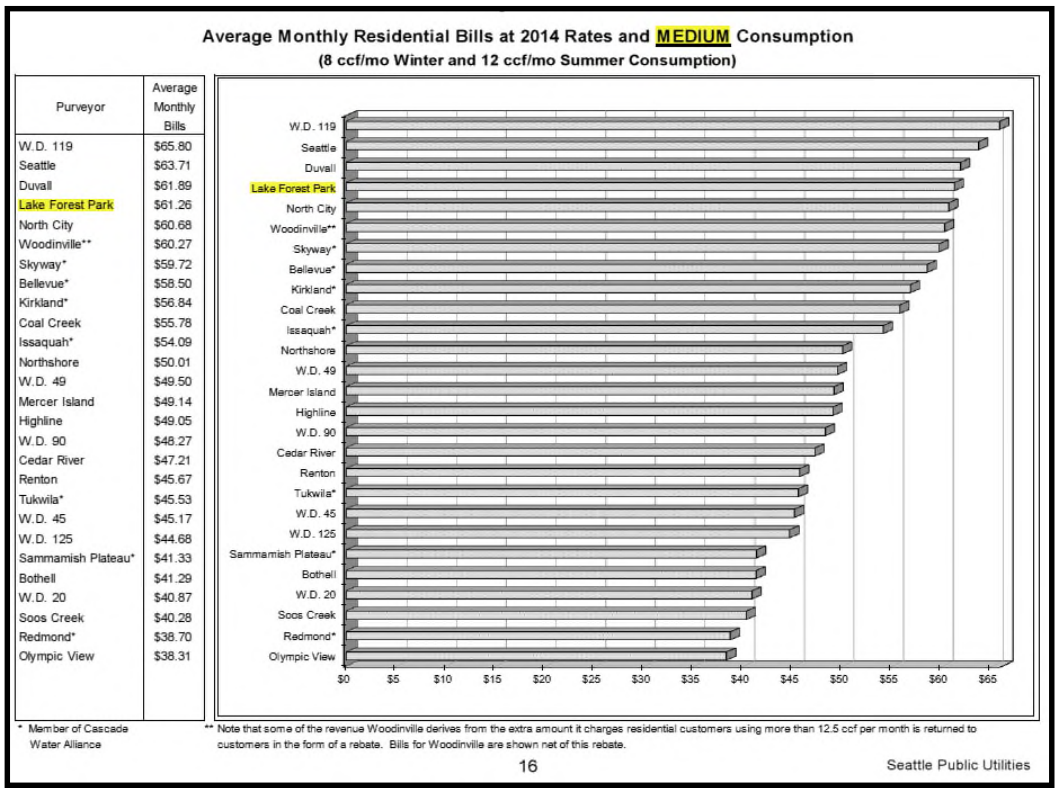


Figure 9-8 Residential Bills Compared: Medium Consumption

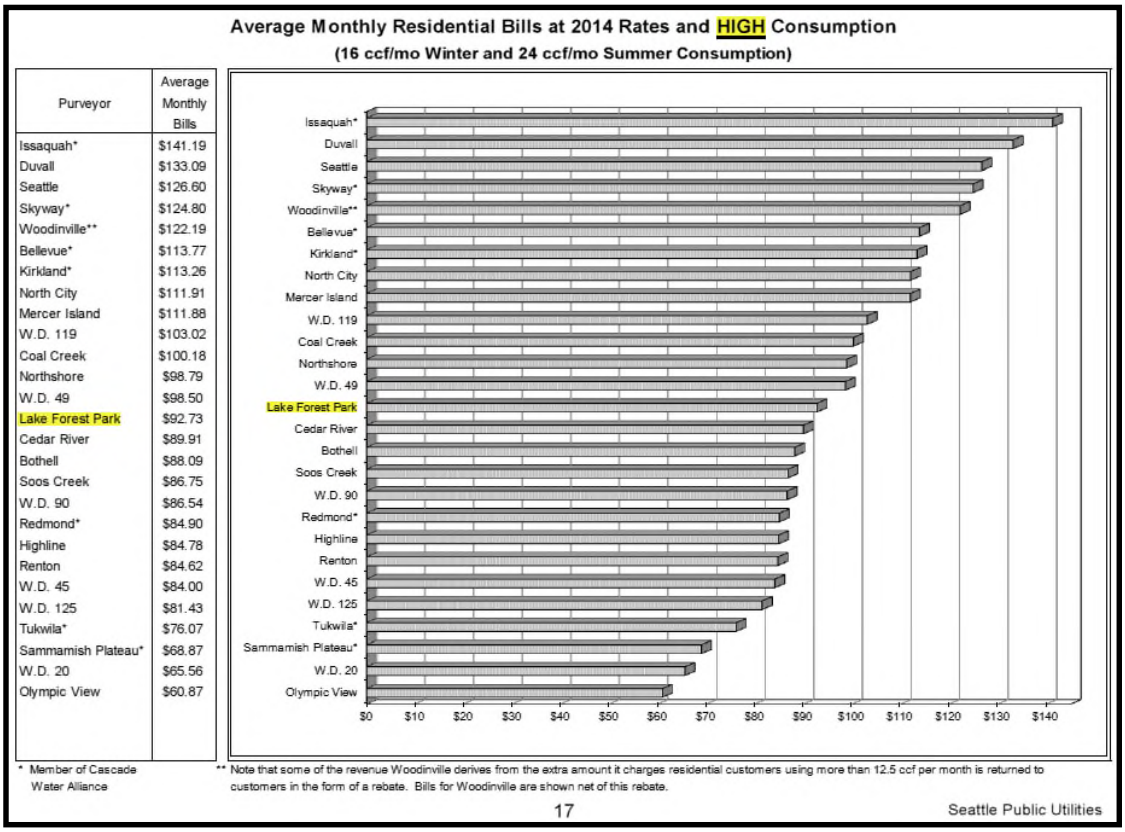


Figure 9-9 Residential Bills Compared: High Consumption

V. WATER SYSTEM DEVELOPMENT CHARGE

INTRODUCTION AND OVERVIEW

This section outlines the basis and methodology used to determine a "System Development Charge" (SDC) for the District. In the utility industry SDC charges are variously referred to as "*connection charges, general facility charges, impact fees, capacity fees, plant investment fees, buy-in fees* etc.

Washington State RCW 57.08.005 provides legal authority for utility districts to assess "*connection charges*" for new customers. SDC charges assure that the costs of developing the water system are equitably distributed between existing customers and future customers when connecting to the system. One source defines SDC this way:

> *"System development charges are one-time charges paid by new development to finance construction of public facilities needed to serve them." (Nelson, 1995)*

PRESENT WATER SYSTEM DEVELOPMENT CHARGES (2006 – 2015)

Existing System Development "Connection Charges" were established by Resolution #297 on August 14, 2006 as indicated in **Table 9-14** (below). These charges were based on an assumed capital asset value of $2,120,367 and 1007 ERU (Equivalent Residential Units) in the system.

# of ERU† Equivalent Weighting Factor	DESCRIPTION	CURRENT SDC BASE CONNECTION CHARGE*
1	5/8 and 3/4 INCH METER	$2,105.63
1.5	1 INCH METER	$3,158.45
	5/8 and 3/4 INCH METER - EXTRA SERVICE	
	1 INCH METER - EXTRA SERVICE	
2.5	1-1/2 INCH METER	$5,264.08
5	2 INCH METER	$10,528.15
8	3 INCH METER	$16,845.04
16	4 INCH METER	$33,690.08
25	5 INCH METER	$52,640.75
50	LOW FLOW 6 INCH METER	$105,281.50
80	8 INCH METER	$168,450.40
	LOW FLOW 8 INCH METER	$168,450.40

† Equivalent Residential Unit

‡ Amount listed is for service to one residence or equivalent. If more than one residence or equivalent is served by one meter, then each additional residence or equivalent residential unit receiving service from that meter shall be charged an additional base of fee of $11.88

*Base connection charge does not include direct costs of new service construction such as meter install fee and associated permit fees.

Table 9-14 Existing System Development Charges by Meter Size

PROPOSED SYSTEM DEVELOPMENT CHARGES (SDC 2015 -)

In the 9 years since 2006 the District has made considerable improvements to water system infrastructure and has also acquired real estate to support utility functions. The following paragraphs describe the methodology and results of updated calculations to determine the current "net allowable SDC" in accordance with Washington State law.

Methods of Determining SDC

There are various methodologies used to determine SDC for water utilities that each have relative advantages or disadvantages depending on the development status of the individual system.

Washington State law has specific authorization under RCW 57.08.005 and allows for inclusion of:

- "Interest charges applied…for a period not to exceed 10 years..at a rate commensurate with the rate of interest applicable to the District at the time of construction...."
- pro-rata share of the cost of existing facilities and facilities planned for construction within the next ten years and contained in an adopted comprehensive plan.

Lake Forest Park Water District does have significant capital expenditures on the horizon but these are mostly upgrades to existing infrastructure and are not development related. In fact, the District is at a mature stage of development. Therefore, the cost of facilities planned for construction within the next ten years will be ignored in the calculation of SDC.

In consideration of the forgoing the District should adopt system development charges that are cost based. The *equity buy-in* method offers the most appropriate approach to ensure equitable distribution of costs between existing and future customers and this method was applied to the analysis. New customers pay only an amount equal to the net investment already made by existing users. Net equity investment is divided by current number of Equivalent Dwelling Units (EDU). Equity buy-in is illustrated in the following framework[1]:

[1] Raftelis Financial Consultants "City of Santa Cruz Water Department System Development Charge Report April 2015

Equity buy-in method of determining SDC requires knowledge of the "current asset value". There are several methods in common use to assess the current value of existing systems. These include:

- ***Original cost*** (cost of construction in the year of construction)
- *Original cost less accumulated depreciation* (net book value)
- *Replacement cost* (original cost escalated to current-day dollars)
- *Replacement cost less accumulated depreciation* (original cost escalated to current-day dollars less depreciation)

In consideration of the provisions in Title 57 the *Original Cost* of construction method was used. In addition, several key assumptions were applied in this analysis:

- Original cost of construction was determined from District records when available. Where original cost was not available this was approximated using an engineer's estimate of 2014 cost and the Engineering News Record (ENR) cost index was used for regression from inflation since the year of construction.
- Capital Infrastructure or Land that is known to have been acquired by grant/settlement or Developer Extension deeding is NOT included in the total.
- Cost of planned facilities is NOT included, even though this is allowed by RCW 57.08.005 because this infrastructure will mostly be funded by un-earned revenue.
- Interest for 10 years following construction was applied using actual historical cost of borrowing. Values were found in minutes of meetings, resolutions and loan or bond sale records then interpolated to cover years for which data were not available. The District issued bonds until the State began the low interest PWTF loan program in the 1980's. Interest rates applicable to bond sales was close to prime lending rate, typically 4 – 7%, whereas PWTF loans have varied from 0.5 – 3%.
- The cost of projects where maintenance and capital improvement were combined is adjusted by a percentage to reasonably approximate the infrastructure improvement cost.

COST OF THE EXISTING FACILITIES AND PROPOSED SYSTEM DEVELOPMENT CHARGE (SDC)

Table 9-15 (below) summarizes cost of existing facilities and land as determined in accordance with RCW 57.08.005 and as described above. Using these methods about 85% of asset value is in transmission and distribution pipes.

A System Development Charge (SDC) of $8,727.00 per ERU is proposed based on 1010.7 ERU in the system. Detailed costing sheets used as the basis for developing SDC values appear in the Appendix of the SDC report.

ASSET DESCRIPTION		Asset Cost*	1010.7 ERU	
		(RCW 57.08.005)	$/ERU	% of Total
Land	Includes office, McKinnon Cr., Horizon View	$337,723	$334	3.5%
ST-001	Low Zone Reservoir	$119,193	$118	1.2%
ST-002	High Zone Standpipe	$103,420	$102	1.1%
ST-003	Standby Tank - Low Zone	$52,246	$52	0.5%
ST-005	Equalizing Tank - Horizon View (50,000 gal)	$200,898	$199	2.1%
SS-001	Wells/Wellheads	$51,066	$51	0.5%
SS-002	Well/Transfer Pumps	$30,352	$30	0.3%
SS-003	Misc. Source/Supply Infrastructure	$44,864	$44	0.5%
Pipe_data2015_watercad	Transmission and Distribution Piping	$8,274,836	$8,187	84.6%
Buildings	Buildings	$116,449	$115	1.2%
Adm/Eq	Administrative-Equipment	$214,724	$212	2.2%
Current Reserve Balances $$		$233,000	$231	2.4%
ASSET TOTALS WITH LAND		**$9,778,771**	**$9,675**	**100.0%**
EXISTING DEBT (subtract from Asset Total)		**$958,121**	**$948**	
NET ALLOWABLE DEVELOPMENT CHARGE		**$8,820,650**	**$8,727**	**per ERU**
file: Raid-2\System Plan Work\Capital Asset Management.xls				
edit: October 22, 2015				

*References SDC cost computed in accordance with Washington RCW 57.08.005 and as described in LFPWD Comprehensive Water System Plan 2015 Part Nine, Section VI

Table 9-15 Proposed System Development Charges per ERU

Table 9-16 below applies the proposed SDC of $8727.00 per ERU to common service pipe sizes.

# of ERU† Equivalent Weighting Factor	Description	Proposed SDC Base Connection Charge*
1	5/8 and 3/4 INCH METER	$8727.00
1.5	1 INCH METER	$13090.50
	5/8 and 3/4 INCH METER - EXTRA SERVICE	TBD upon application
	1 INCH METER - EXTRA SERVICE	TBD upon application
2.5	1-1/2 INCH METER	$21817.50
5	2 INCH METER	$43635.00
	Other sizes larger than 2 inch	TBD upon application

† Equivalent Residential Unit

‡ Amount listed is for service to one residence or equivalent. If more than one residence or equivalent is served by one meter, then each additional residence or equivalent residential unit receiving service from that meter shall be charged an additional base of fee of $11.88

*Base connection charge does not include direct costs of new service construction such as meter install fee and associated permit fees.

Table 9-16 Proposed System Development Charges by Meter Size

The information presented in this report is based on our understanding of the relevant Washington law relating to system development charges. It in no way constitutes a legal interpretation of Washington State law by Mundall Engineering & Consulting. It is recommended that the SDC be re-assessed by the District whenever there are important changes to the system.

VI. CAPITAL ASSET EVALUATION – GASB 34

INTRODUCTION AND OVERVIEW

The Governmental Accounting Standards Board's(GASB) Statement No.34 among other things, requires that State and Local governments account for depreciation of their infrastructure assets. Technically GASB 34 only applies to infrastructure constructed or significantly improved since June 30, 1980. However a more complete accounting was made of all significant depreciable infrastructure in the District, some of which dated back as far as 1940. Infrastructure was assessed in the following categories with assumed straight line depreciation applied as follows:

- Storage reservoirs (tanks), 50 years
- Wells, wellheads, 50 years
- Pumps, 25 years
- Transmission and Distribution Piping, 50 – 100 years depending on pipe material
- Buildings, 50 years
- Administrative – Equipment, 10 years

Engineering News Record (ENR) Construction Cost Index was used to adjust the various infrastructure values into constant (2014) dollars. Infrastructure evaluation was relatively straightforward except for transmission and distribution piping, which is made up of about 260 sections each having distinct construction age, material and size characteristics. Excel spreadsheet formulas with lookup tables were used to assess each section of pipe, including piping that is proposed for construction over the next 20 years as part of the District's CIP outlined in Part Eight of this document.

PIPE DIA.	2014 VALLUE PER FOOT
1	**30**
2	**40**
3	**50**
4	**160**
5	**170**
6	**180**
8	**220**
10	**240**
12	**250**

Other critical assumptions were made in order to simplify calculation. These include:

- Pipe network is assumed to remain the same size over time, even though in fact there are some new pipes added that are not replacement.
- Previous generation pipe is assumed to be steel, constructed in 1950 with a 50 year depreciable life.
- Future pipe construction is assumed to be ductile iron or HDPE with depreciable lifespan of 100 years.
- Pipe construction cost is assumed to be the same for all materials of construction
- Values were assumed for pipe construction in 2014 as seen in the table here and are nominalized from recent construction projects in the District.
- Capital improvements to various infrastructure such as reservoir mixing system etc. are included, but maintenance costs such as reservoir cleaning are not included. A percentage is applied to some projects which combine both maintenance and capital infrastructure improvement

GASB 34 Compliance Assessment Findings

Figure 9-10 (below) summarizes the value of the District's capital assets over the years 1994 through 2034 in constant (2014) dollars. These figures indicate that the value of depreciable infrastructure in the District has increased about 36% in constant dollars from $9.1 Million to $12.4 Million over the past 20 years as the District has been aggressively replacing steel piping constructed in the 1950's and constructing new piping, reservoirs, buildings and wells. The GASB 34 value is expected to remain above $12 Million over the next 10 years as the District continues its ambitious program of infrastructure upgrades.

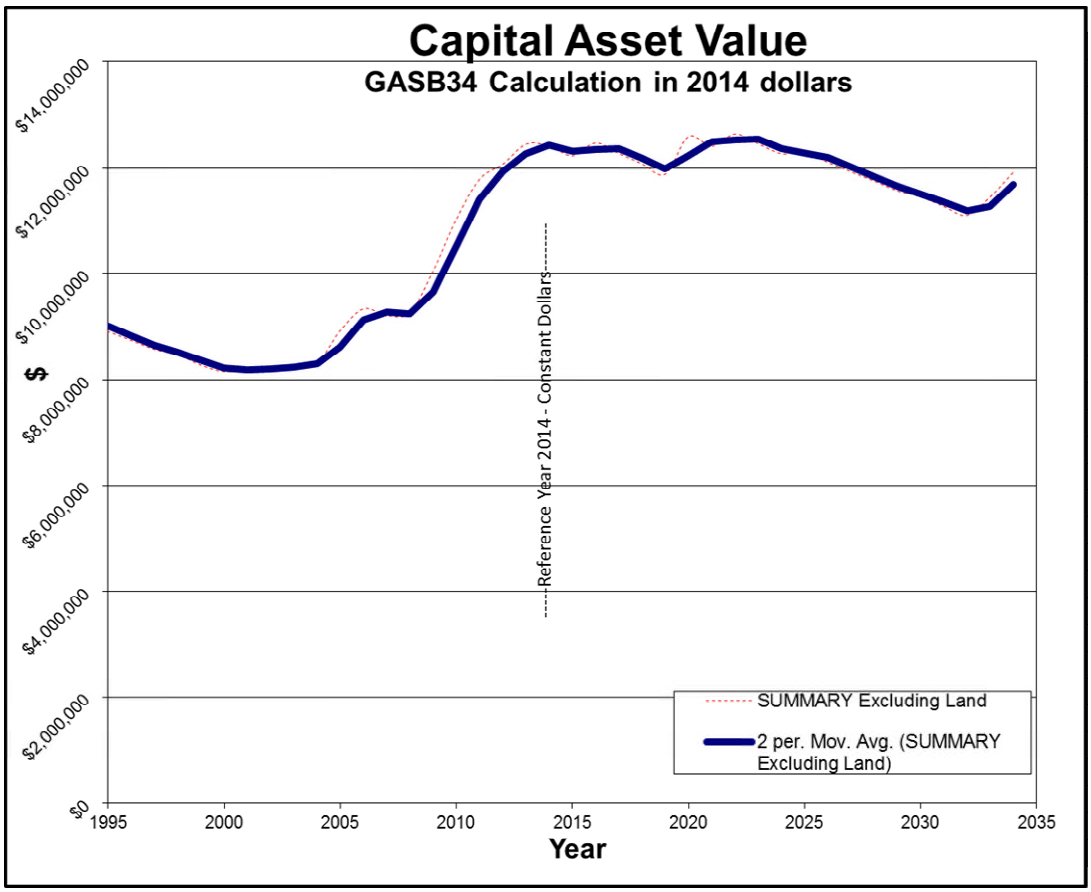


Figure 9-10 Capital Asset Value (GASB 34)

Table 9-17 (below) offers further detail regarding capital asset values over the period 1994 – 2034. Note that transmission and distribution piping makes up between 85% – 95% of total depreciable assets. The depreciable lifespan values used for the various infrastructure are conservative. For instance, water wells may last considerably longer than 50 years, and new ductile iron and HDPE piping installed in the District may have a useful life much greater than 100 years, as was applied for this analysis. GASB 34 depreciation rates should be re-assessed in the future as evidence of greater lifespan may become available for piping and other infrastructure.

GASB 34 Capital Asset Value

(Calculation in 2014 dollars)

Year	Land	Low Zone Reservoir ST-001	High Zone Standpipe ST-002	Standby Tank - Low Zone ST-003	Equalizing Tank - Horizon View (50,000 gal) ST-005	Wells/Wellheads SS-001	Well/Transfer Pumps SS-002	Misc. Source/Supply Infrastructure SS-003	Transmission and Distribution Piping Dist	Buildings Buildings	Administrative-Equipment Adm/Eq	SUMMARY Excluding Land	ASSET TOTALS
1994	815,000	232,197	122,639	0	0	150,352	55,359	47,657	8,645,835	101,448	0	$9,355,485	$10,170,485
1995	815,000	227,553	120,186	0	0	147,345	53,144	46,703	8,457,197	99,419	0	$9,151,547	$9,966,547
1996	750,000	223,002	135,231	0	0	144,398	51,019	54,494	8,268,559	97,431	0	$8,974,131	$9,724,131
1997	822,000	218,541	132,526	0	0	158,341	59,278	53,404	8,079,921	95,482	0	$8,797,493	$9,619,493
1998	822,000	214,171	192,819	0	0	171,739	71,907	52,336	7,891,283	93,572	0	$8,687,826	$9,509,826
1999	1,041,000	209,887	188,963	0	0	168,304	69,030	51,289	7,702,645	91,701	0	$8,481,819	$9,522,819
2000	1,120,000	205,690	185,184	0	0	164,938	66,269	50,263	7,514,007	89,867	78,814	$8,355,031	$9,475,031
2001	1,208,000	201,576	181,480	0	0	161,639	63,618	64,717	7,533,734	88,069	103,397	$8,398,231	$9,606,231
2002	1,267,000	257,538	177,850	59,994	0	158,406	61,074	63,423	7,434,465	86,308	93,058	$8,392,116	$9,659,116
2003	1,342,000	289,010	174,293	58,794	0	155,238	58,631	62,155	7,489,149	84,582	83,752	$8,455,603	$9,797,603
2004	1,391,000	283,229	170,808	57,618	0	152,133	71,286	60,911	7,421,761	89,781	181,499	$8,489,027	$9,880,027
2005	1,390,000	284,150	167,391	56,466	0	149,091	83,434	59,693	8,013,960	87,986	187,713	$9,089,884	$10,479,884
2006	1,668,000	278,467	164,044	55,336	0	146,109	80,097	58,499	8,453,792	86,226	168,942	$9,491,511	$11,159,511
2007	1,784,000	272,897	160,763	54,230	0	143,187	76,893	57,329	8,356,743	84,502	152,047	$9,358,591	$11,142,591
2008	1,998,000	267,439	157,547	53,145	0	140,323	73,817	56,183	8,443,159	82,811	136,843	$9,411,268	$11,409,268
2009	1,879,000	262,091	154,396	52,082	0	376,229	70,864	55,059	9,003,421	81,155	134,601	$10,189,898	$12,068,898
2010	2,079,400	256,849	252,835	51,041	0	368,704	68,030	53,958	9,921,364	79,532	121,141	$11,173,452	$13,252,852
2011	2,078,000	251,712	247,778	60,831	0	361,330	65,309	52,879	10,690,374	77,942	109,027	$11,917,181	$13,995,181
2012	2,078,000	259,320	242,823	59,615	0	354,103	62,696	51,821	10,982,985	87,969	98,124	$12,199,456	$14,277,456
2013	2,078,000	254,133	237,966	58,422	202,000	347,021	152,188	50,785	10,865,049	312,178	88,311	$12,568,055	$14,646,055
2014	2,078,000	249,051	233,207	57,254	200,960	340,081	146,101	49,769	10,870,272	305,935	79,480	$12,532,109	$14,610,109
2015	2,078,000	244,070	228,543	56,109	196,941	333,279	140,257	48,774	10,722,438	299,816	71,532	$12,341,758	$14,419,758
2016	2,078,000	239,188	223,972	54,987	193,002	326,614	534,647	47,798	10,600,815	293,820	64,379	$12,579,220	$14,657,220
2017	2,078,000	234,404	219,492	53,887	189,142	320,081	513,261	46,842	10,452,719	287,943	57,941	$12,375,713	$14,453,713
2018	2,078,000	229,716	215,103	52,809	190,359	313,680	492,730	45,905	10,305,405	282,184	52,147	$12,180,039	$14,258,039
2019	2,078,000	225,122	210,801	51,753	186,552	307,406	473,021	44,987	10,158,091	276,541	46,932	$11,981,206	$14,059,206
2020	2,078,000	220,620	206,584	50,718	182,821	301,258	454,100	44,088	10,955,002	271,010	0	$12,686,200	$14,764,200
2021	2,078,000	216,207	202,453	49,704	179,164	295,233	435,936	43,206	10,807,688	265,590	0	$12,495,180	$14,573,180
2022	2,078,000	291,883	198,404	48,709	175,581	289,328	418,499	42,342	11,002,611	260,278	0	$12,727,635	$14,805,635
2023	2,078,000	286,045	194,436	47,735	172,070	283,542	401,759	41,495	10,855,297	255,072	0	$12,537,450	$14,615,450
2024	2,078,000	280,324	190,547	46,781	168,628	277,871	385,689	40,665	10,707,983	249,971	0	$12,348,458	$14,426,458
2025	2,078,000	274,718	186,736	45,845	165,256	272,313	370,261	39,852	10,769,646	244,971	0	$12,369,598	$14,447,598
2026	2,078,000	269,224	183,001	44,928	161,950	266,867	355,451	39,055	10,622,138	240,072	0	$12,182,686	$14,260,686
2027	2,078,000	263,839	179,341	44,030	158,711	261,530	341,233	38,274	10,474,630	235,270	0	$11,996,858	$14,074,858
2028	2,078,000	258,562	175,754	43,149	165,537	256,299	327,583	37,508	10,327,122	230,565	0	$11,822,081	$13,900,081
2029	2,078,000	253,391	172,239	42,286	162,227	251,173	314,480	36,758	10,179,614	225,954	0	$11,638,122	$13,716,122
2030	2,078,000	248,323	233,795	41,440	158,982	246,150	301,901	36,023	10,032,106	221,435	0	$11,520,154	$13,598,154
2031	2,078,000	243,357	229,119	40,611	155,802	241,227	289,825	35,302	9,884,598	217,006	0	$11,336,847	$13,414,847
2032	2,078,000	253,490	224,536	39,799	152,686	236,402	278,232	34,596	9,737,090	212,666	0	$11,169,498	$13,247,498
2033	2,078,000	248,420	220,046	39,003	164,633	231,674	267,102	33,904	10,100,688	208,413	0	$11,513,883	$13,591,883
2034	2,078,000	243,451	215,645	38,223	161,340	227,041	256,418	33,226	10,596,845	204,244	0	$11,976,434	$14,054,434

file: Raid2:\System Plan Work\Capital Asset Management.xls
edit: Oct. 7, 2015

Table 9-17 GASB 34 Capital Asset Value

VII. FINANCIAL STRUCTURE

ADMINISTRATION OF CUSTOMER BILLING AND REVENUE

District revenue is almost entirely derived from customer payments relating to water service and new service connections. There are special fees applied to customer bills for specific purposes, such as:

- Capital Improvement Fee (established by Resolution)
- LFP City franchise fee (since 2009)
- Washington State excise tax for water utility

Billing statements are produced every two months and delivered by mail. Presently all payments are received in the form of check at the following locations:

- US Mail to District office
- Hand delivery to drop box at 178th Street
- Delivery to District office drop box
- Payment in person at District office

Alternate methods of payment such as "Bill Pay" are used by some customers although these services still process payment by check. The District may consider establishment of a program to accept electronic payments through debit or credit card, however, cost issues must be resolved.

Customer payments are batch processed weekly by the Administrative Assistant or Contracted Bookkeeper and hand delivered to the Deposit Account. Under Washington State law all funds for special purpose districts are administered by the local county government, in this case King County.

Accounts payable are processed in regular batches twice monthly. The District prepares a voucher approval summary document which is electronically forwarded to King County. Payment instruments are then issued by the County.

PART TEN MISCELLANEOUS DOCUMENTS

I. PROPERTIES IN LFPWD CORPORATE BOUNDARY CURRENTLY SERVED BY OTHER UTILITIES

Table 10-1 and **Table 10-2** below list individual properties that are within the LFPWD corporate boundary but are currently served by others along with several properties that are in areas currently not annexed to either district (blue font).

SERVED BY NUD	57	
5252 NE 184TH ST		4908 NE 193RD ST
4706 NE 187TH PL		18723 37TH AVE NE
4716 NE 187TH PL		18725 37TH AVE NE
4726 NE 187TH PL		18801 37TH AVE NE
4736 NE 187TH PL		18807 37TH AVE NE
4904 NE 187TH PL		18811 37TH AVE NE
4905 NE 187TH ST		18810 39TH AVE NE
4907 NE 187TH ST		18803 46TH AVE NE
4909 NE 187TH ST		18804 46TH AVE NE
4911 NE 187TH ST		18809 46TH AVE NE
4921 NE 187TH ST		18912 46TH AVE NE
5001 NE 187TH ST		18915 46TH AVE NE
5005 NE 187TH ST		18920 46TH AVE NE
5015 NE 187TH ST		18925 46TH AVE NE
5025 NE 187TH ST		18756 47TH AVE NE
5103 NE 187TH ST		18757 47TH AVE NE
5117 NE 187TH ST		18762 47TH AVE NE
5119 NE 187TH ST		18808 47TH AVE NE
5121 NE 187TH ST		19005 47TH PL NE
5123 NE 187TH ST		19015 47TH PL NE
5201 NE 187TH ST		19017 47TH PL NE
5207 NE 187TH ST		19037 47TH PL NE
5215 NE 187TH ST		19045 47TH PL NE
5223 NE 187TH ST		19102 47TH PL NE
4603 NE 189TH PL		18517 53RD AVE NE
4609 NE 189TH PL		18521 53RD AVE NE
4616 NE 189TH PL		18523 53RD AVE NE
4618 NE 189TH PL		
4619 NE 189TH PL		
4620 NE 189TH PL		

Table 10-1 Properties Currently Served by NUD

SERVED BY NCWD	33	
3855 NE 178TH ST		2601 NE 185TH ST
3859 NE 178TH ST		2617 NE 185TH ST
4005 NE 178TH ST		2619 NE 185TH ST
4015 NE 178TH ST		2621 NE 185TH ST
4027 NE 178TH ST		2911 NE 185TH ST
4039 NE 178TH ST		2919 NE 185TH ST
4045 NE 178TH ST		2921 NE 185TH ST
4411 NE 178TH ST		18409 29TH AVE NE
2912 NE 178TH ST		18415 29TH AVE NE
2924 NE 178TH ST		18421 29TH AVE NE
2926 NE 178TH ST		17840 33RD AVE NE
2942 NE 178TH ST		17855 33RD AVE NE
2946 NE 178TH ST		17420 44TH AVE NE
2960 NE 178TH ST		17426 44TH AVE NE
3037 NE 180TH ST		2606 NE PERKINS WAY
3047 NE 180TH ST		
3055 NE 180TH ST		
3519 NE 180TH ST		(Not annexed to either district)

Table 10-2 Properties Currently Served by NCWD

II. PROPERTIES OUTSIDE LFPWD CORPORATE BOUNDARY CURRENTLY SERVED BY DISTRICT

SERVED BY LFPWD OUTSIDE BOUNDARY	4	
ADDRESS		**CORPORATE BOUNDARY**
3369 NE 178TH ST		NCWD
3377 NE 178TH ST		NCWD
4029 NE 178TH ST (LFPWD District office)		NCWD
18500 NE 53RD AVE		NUD
18504 NE 53RD AVE		NUD
ref: raid-2\\System Plan Work\2015 Comp Plan\LFPWD_Parcels_Serviced.xls		
edit: 7/13/16		

Table 10-3 Properties Currently Served by LFPWD Outside Corporate Boundary

III. SAMPLE CUSTOMER BILL

LAKE FOREST PARK WATER DISTRICT

4029 N.E. 178th St.
Lake Forest Park, WA 98155
Phone: (206) 365-3211
Email: Office@LFPWD.org
Web: www.LFPWD.org

Statement Date: Apr 30, 2015
Account Number: xxxx
Date Due: Apr 30, 2015
Amount Due: $83.89

Service Address:
xxxxx 49TH PL NE
LAKE FOREST PARK

DEAR CUSTOMER
XXXXX 49TH PL NE
LAKE FOREST PARK , WA 98155 -4314

For Period Ending: Apr 30, 2015

Description	Amount
Previous Balance	$87.23
Payment	($87.23)
Meter rate	$37.00
Water usage $3.00 / 100 Cubic Feet	$24.00
WA State fees @ 5.029%	$3.23
City of LFP fees @ 6%	$3.66
Capital improvement	$16.00

SAMPLE

Current Reading: 686
Current Usage: 8

Total Due **$83.89**

Lake Forest Park Water District does not add fluoride to your water.

Please return this portion with your payment.

DEAR CUSTOMER
XXXXX 49TH PL NE
LAKE FOREST PARK , WA 98155 -4314

Statement Date: Apr 30, 2015
Account Number: XXXX
Date Due: Apr 30, 2015
Amount Due: $83.89
Amount Paid: _____

Service Address
XXXXX 49TH PL NE
LAKE FOREST PARK

Lake Forest Park Water District (KCWD 83)
4029 N.E. 178th St.
Lake Forest Park, WA 98155

Table 10-4 Sample Customer Bill

IV. S.E.P.A. CHECKLIST & SUBMISSION

DETERMINATION OF NON-SIGNIFICANCE
WAC 197-11-970

Description of Proposal:	Adoption of Updated Comprehensive System Plan. Population projections were made over a twenty year period. Existing facilities were reviewed to determine their adequacy of current and future projections. Water system recommended improvements are identified and scheduled.
Proponent:	Lake Forest Park Water District.
Location of Proposals:	Service area solely within the boundaries of the City of Lake Forest Park.
Lead Agency:	Lake Forest Park Water District.

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)©. This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

a. There is no comment period for this DNS.
b. This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 15 days from the date below. Comments must be submitted by ----------.

Responsible Official:	Alan Kerley
Position/Title:	General Manager
Address:	Lake Forest Park Water District 4029 NE 178th Street Lake Forest Park, WA 98155

Date: _____ Signature: _____

IV. S.E.P.A. CHECKLIST & SUBMISSION

DETERMINATION OF NON-SIGNIFICANCE
WAC 197-11-970

Description of Proposal:	Adoption of Updated Comprehensive System Plan. Population projections were made over a twenty year period. Existing facilities were reviewed to determine their adequacy of current and future projections. Water system recommended improvements are identified and scheduled.
Proponent:	Lake Forest Park Water District.
Location of Proposals:	Service area solely within the boundaries of the City of Lake Forest Park.
Lead Agency:	Lake Forest Park Water District.

The lead agency for this proposal has determined that it does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)©. This decision was made after review of a completed environmental checklist and other information on file with the lead agency. This information is available to the public on request.

a. There is no comment period for this DNS.
b. This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 15 days from the date below. Comments must be submitted by 9/26/2016.

Responsible Official:	Alan Kerley
Position/Title:	General Manager
Address:	Lake Forest Park Water District 4029 NE 178th Street Lake Forest Park, WA 98155

Date: 9/8/2016 Signature: A. Kerley

ENVIRONMENTAL CHECKLIST

BACKGROUND

1. Name of proposed project (if applicable):
   Lake Forest Park Water District Comprehensive System Plan.

2. Name of Applicant:
   Lake Forest Park Water District.

3. Address and phone number of applicant and contact person:
   Lake Forest Park Water District
   4029 NE 178th Street
   Lake Forest Park, WA 98155

   Mr. Alan Kerley
   (206) 365-3211

4. Date checklist prepared:
   May 2015

5. Agency requesting checklist:
   Lake Forest Park Water District.

6. Proposed timing or schedule (including phasing, if applicable):
   Adoption of Comprehensive System Plan -- Fall 2015.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.
   The Lake Forest Park Water District will implement the comprehensive plan according to the construction schedule outlined in Chapter 8 of the plan.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.
   None.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.
   None.

10. List any government approvals or permits that will be needed for your proposal, if known.
    - **City of Lake Forest Park Approval.**
    - **King County Approval.**
    - **Washington State Department of Health Approval.**

11. Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask

you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information of project description.)

The Comprehensive System Plan discusses the existing and future service area characteristics, population, and land use, and projects the growth within the District service area. The plan discusses design criteria, water demand, the existing system and proposed improvements.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonable available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

Lake Forest Park Water District is located entirely within the boundaries of the City of Lake Forest Park. A map of the service area is attached.

EVALUATION FOR AGENCY USE ONLY

TO BE COMPLETED BY APPLICANT

ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site (circle one):
Flat, rolling, hilly, steep slopes, mountainous, other Wooded with steep slopes; irregular terrain.

b. **What is the steepest slope on the site (approximate percent slope)? 40%**

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck): If you know the classification of agricultural soils, specify them and note any prime farmland. Ans: **Topsoil, Sand, Silt**

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.
Some erosion and landslide activity has occurred within the boundaries. Each project identified in Chapter 8 of the plan will be reviewed for compliance with the current Critical Areas Ordinance for the City of Lake Forest Park.

e. Describe the purpose, type and approximate quantities of any filling or grading proposed. Indicated source of fill.
No filling is anticipated. Grading in approximate quantity 50 cu-yd

Water line trenches will be excavated and backfilled as much as possible with native material. The City of Lake Forest Park may require imported backfill depending on condition and type of native soil. Bedding and backfill will come from local suppliers.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.
Erosion during construction is possible but should be minimal. Construction erosion requirements will be imposed. Construction will typically take place in the public right-of-way, minimizing or eliminating the need for additional clearing.

g. About what percent of the site will be covered with imperious surfaces after project construction (for example, asphalt or buildings)?

There are no plans to cover water lines with impervious surfaces other than those existing in the right-of-way. These include asphalt and concrete road surfaces.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:
The construction documents will require the Contractor to utilize temporary erosion and sedimentation control measures to prevent erosion and sedimentation control measures to prevent erosion by covering erodable embankments, hydoseeding, filter fabric and straw bale filters and other measures as necessary to meet local and state requirements. The Contractor will be required to schedule operations such that the excavation, embankment and restoration work proceeds commensurate with their ability to complete restoration, mulching, seeding, and other erosion control measures immediately following disturbances of the earth. Implementing best management practices will minimize erosion during construction.

2. Air

a. What types of emissions to the air would result from the proposal (ie., dust, automobile, odors, industrial, wood smoke) during construction and when the project is completed? If any, generally describe and give approximate quantities if known.

Normal dust and machinery emissions during construction with no emissions after construction. The Contractor will be required to limit emissions as required by the appropriate regulatory agencies and to control dust emissions so as not to damage property or vegetation or create a nuisance for the public. There could be diesel exhaust from use of standby generators if used for standby power or testing of equipment.

b. Are there any off-site sources of emissions or odor that my affect your proposal? If so, generally describe.
No.

c. Proposed measures to reduce or control emissions or their impacts to air, if any:

The Contractor will be required to control dust during construction via sweeping, watering and washing.
Greenhouse Gas Reduction Policy includes procedures to reduce impacts to air.

3. Water

a. Surface:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands). If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

The area served by the District contains several streams that flow into the Lake Washington drainage basin. Some of the streams contain water only during the winter months. The two major streams which flow all year are McAleer and Lyons Creeks. Both these creeks originate in Snohomish County and flow into Lake Washington.

Lake Washington is the only major body of water and is located at the very southern boundary of the District. There are several small, man-made ponds located throughout the District's service area.

2) Will the project require any work over, in or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

Individual projects will be designed and constructed in compliance with all applicable local, State and Federal requirements. Some projects will require construction within 200 feet of said waters and will be subject to the appropriated permits.

3) Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicated the area of the site that would be affected. Indicate the source of fill material.

Generally, all areas impacted by construction will be restored to original contours. Construction will consist of excavation of water line trench (average 4 feet deep, @ 2/3 cubic yards per foot of trench) and installation of pipe and backfill with native materials. If required by the City, due to poor materials and close proximity to or location within the roadway, backfill gravel will replace native material in about two-thirds of the trench cross-section (one cubic yard per foot of trench). Backfill gravel would come from local material yards.

4) Will the proposal require surface water withdrawals for diversions? Give general description, purpose and approximate quantities if known.
No.

5) Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.
No.

6) Does the proposal involve any discharges of waster materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.
No.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.
There is no plan to withdraw ground water beyond that covered in current water withdrawal licenses. There is no plan to inject water into the ground.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals . . .; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.
None under this proposed plan.

c. Water Runoff (including storm water):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known) Where will this water flow? Will this water flow into other waters? If so, describe.
The finished projects will not result in an appreciable amount of impervious area, with the exception of additional crushed rock surfacing on existing roadway shoulders as may be required by the City.

Storm water runoff impacting the construction zone will be intercepted for sedimentation control prior to release to its normal outfall.

The Contractor will be required to utilize sedimentation control facilities per the specifications and local, state and federal requirements to ensure that sediment-laden water does not enter the natural drainage system.

2) Could waste materials enter ground or surface waters? If so, generally describe. NO

d. Proposed measures to reduce or control surface, ground and runoff water impacts, if any:

- **Stormwater filtration and oil/water separators are considered desirable at McKinnon Creek wellfield to protect the wellfield from storm runoff.**

4. Plants

a. Check or circle types of vegetation found on the site?

X **Deciduous tree: *alder, maple, aspen, other*:**
X **Evergreen tree: *Douglas-fir, red cedar, pine, other***
X **Shrubs**
X **Grass**
___ **Pasture**
___ **Crop or grain**
___ **Wet soil plants: *cattail, buttercup, bulrush, skunk cabbage, other***
___ **Water plants: *water lily, eelgrass, milfoil, other***

b. What kind and amount of vegetation will be removed or altered?

Low growing vegetation such as grasses, forbs and small shrubs and tress along the roadside shoulders may be directly affected by excavation within existing rod right-of-ways. Cut trees will be replaced with native plant nursery stock, and the road shoulder and ditch areas will be reseeded with native grasses and forbs.

c. List threatened or endangered species known to be on or near the site.

None known.

Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Avoidance: **The following measures may be incorporated into the construction plans to avoid impacts to existing plant communities and other wildlife habitat features.**

- **Projects will be planned to limit construction impact to within existing road right-of-ways and limit excavation of road shoulders where feasible.**
- **Large trees and native plants of significance will be flagged and avoided where feasible.**

Reduction of Unavoidable Impacts: **The following measures will be incorporated into the construction plans to reduce unavoidable impacts too existing plant communities and other wildlife habitat features.**

- **Vegetation will be cleared, where needed, or laid-over rather than graded.**
- **Topsoil from the trench will be stockpiled separately for short periods of time and replaced above the subsoil fill. This approach will allow for the survival of plant regenerative parts (roots, stems, rhizomes and seeds) present in the existing topsoil.**
- **Silt fences and hay bales will be placed in areas of steep slope to avoid erosion and sedimentation of wetland plant communities.**

Compensatory Mitigation Measures: The following measures will be incorporated into the construction plans to compensate for unavoidable impacts to existing plant communities and other wildlife habitat features.

- Large woody debris will be left on-site as nurse longs and wildlife habitat features.
- Disturbed areas will be hydroseeded with a seed mixture containing native grasses and forbs.
- Native plant tree and shrub nursery stock will be planted to compensate for unavoidable loss of larger trees and portions of native plant communities.

5. Animals

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

Birds: hawk, heron, eagle, songbirds, other: crow
Mammals: deer, bear, elk, beaver, other: mountain beaver

Fish: bass, salmon, trout, herring, shellfish, other

b. List any threatened or endangered species known to be on or near the site.
Contact with both the NMFS and USEWS for work in this area of King County indicate that, as of the date of this checklist preparation, the only salmon species under their jurisdiction listed as an endangered species is the Puget Sound Chinook and possible bull trout. On-going fishery inventory studies will indicate the presence or absence of these species. The City and King County both have several salmon watcher sites located on both McAleer and Lyons Creeks. Depending on the information from these sources, the construction period may be prohibited during months when salmon are present in these streams.

c. Is the site part of a migration route? If so, explain.
The area is not part of a migration route for large mammals. Several species of fish, such as Chinook, Coho and Sockeye use McAleer Creek for migration and spawning. It is assumed these same species also use Lyons Creek. Songbirds may also use this area for migration and other birds as part of their annual north-south migration.

d. Proposed measures to preserve or enhance wildlife, if any:
Control of access to McKinnon Creek wellfield will enhance habitat for birds and small mammals that are found there.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Diesel fueled construction equipment. Electric water pumps. Actually the proposed project will result in a net savings of energy as pump & pipe replacement will increase efficiency and reduce leakage.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe. **No.**

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:
- **Zone metering is proposed to improve water use efficiency and reduce unaccounted water**
- **Operational practices to reduce un-necessary pumping in the supply system.**

- **Greenhouse gas reduction policy adopted by District and included in this plan will improve energy use**
- **Replacement of failing, leaking watermains will reduce un-accounted water and thus reduce total water production and its associated energy demand.**

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous wastes, that could occur as a result of this proposal? If so, describe.

The main risk would occur during construction from machinery and construction practices. This could include spills of small amounts of oil and gas because of improper filling and or other machinery failures.

1) Describe special emergency services that might be required.
Spill clean up services and isolation during construction. The District has an Emergency Response Plan that we follow.

2) Proposed measures to reduce or control environmental health hazards, if any:
Contractors are required to ensure all personnel are properly trained and construction equipment is properly maintained as required by WISHA.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?
None.

2) What types and levels of noise would be created by or associated with the project on a short-term or long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

During construction, noise levels will increase from construction equipment during normal working hours. Periodic testing and operation of standby generators during power outages will generate noise for short periods of time. Following construction, noise levels will return to their previous levels.

3) Proposed measures to reduce or control noise impacts, if any:

Normal construction activity will be limited to daytime. Construction noise will be regulated by federal, state and local noise standards. The Contractor will be required to ensure proper maintenance of equipment.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties?
Most of the service area has been developed as single family residences. Commercial activities are limited to the Lake Forest Park Towne Centre, Lake Forest Park Elementary School and a few small businesses along Ballinger Way. There are no industrial land uses in the study area.

b. Has the site been used for agriculture? If so, describe.
No.

c. Describe any structures on the site.
Typically, the site is within public right of way, and is free of structures. The actual site will vary depending on the project.

d. Will any structures be demolished? If so, what?
Nothing that we are aware of at this time.

e. What is the current zoning classification of the site?
Residential (90%)

f. What is the current comprehensive plan designation of the site?
All areas are within the boundaries of the City of Lake Forest Park.

g. If applicable, what is the current shoreline master program designation of the site? **N/A**

h. Has any part of the site been classified as an "environmentally sensitive area? If so, specify.
Some areas where water pipes will be installed are environmentally sensitive. Scheduling will be arranged to minimize impacts of erosion and disruption of biota.

i. Approximately how many people would reside or work in the completed project?

Year	2015	2020	2033
Population	2557	2639	2759

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:
None.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

Review of plan and approval by King County, City of Lake Forest Park, Washington State DOE.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.
None.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.
None.

c. Proposed measures to reduce or control housing impacts, if any:
None.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?
A new pumphouse is proposed with a proposed roofline of about 16 feet.

b. What views in the immediate vicinity would be altered or obstructed?
The proposed pumphouse at #18460 47th PL NE will obstruct local views to the west at #18456 47th PL NE.

c. Proposed measures to reduce or control aesthetic impacts, if any
- **Location of pumps in basement pump gallery with ground level pumphouse controls and office above pipe gallery**

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

Dark color roofing is proposed to reduce glare.

b. Could light or glare from the finished project be a safety hazard or interfere with view?
No.

c. What existing off-site sources or light or glare may affect your proposal:
None.

d. Proposed measures to reduce or control light and glare impacts, if any:
None.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?
None.

b. Would the proposed project displace any existing recreational uses? If so, describe.
No.

c. Proposed measures to reduce or control impacts or recreation, including recreation opportunities to be provided by the project or applicant, if any:
None.

13. Historic and Cultural Preservation

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.
No.

b. Generally describe any landmarks or evidence of historic, archaeological scientific, or cultural importance known to be on or next to the site.
None.

c. Proposed measures to reduce or control impacts, if any:
None.

14. Transportation

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.
City roads and state highways provide public access to and through the District.

b. Is site currently served by public transit? If not, what is the approximated distance to the nearest transit stop:

Yes, METRO transit local and express service, Sound transit and Community Transit provide service throughout the Districts' service are.

c. How may parking spaces would the completed project have? How many would the project eliminate?
None.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).
No.

Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.
No.

f. How may vehicular trips per day would be generated by the completed project? If know, indicate when peak volumes would occur.
There would be no change from existing operations.

g. Proposed measures to reduce or control transportation impacts, if any:
During construction both signage and flaggers will be required to control traffic.

15. Public Services

a. Would the project result in an increased need of public services (for example: Fire protection, police protection, health care, schools, other)? If so, generally describe.
No.

b. Proposed measures to reduce or control direct impacts on public services, if any.
No.

16. Utilities

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other-cable TV/Internet.

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.
Future construction activities, specific for each project, will consist of trenching for water line installation and restoration. The Lake Forest Park Water District will operate and maintain the completed systems.

SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: J. M. G

Title: General Manager

Date Submitted: 9/8/2016