French Creek Water System Master Plan Update 2020 – Revision 1

French Creek, British Columbia

Prepared for:

EPCOR Water West

Prepared by:

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Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by EPCOR Water (West) Inc. (EPCOR) to provide the French Creek 2020 Water System Master Plan Update. This Revision 1 update, completed in 2023, is an interim update to the 2020 Master Plan that incorporates the booster pump station detailed design, Waterlines Resources Inc. water supply investigation and Stantec water system demands and design standards review. This interim update also includes the recommendations provided by the Ministry of Water, Lands and Resource Stewardships Water Utility Regulation Section of the Water Management Branch after a review of the EPCOR French Creek – Water System Demands and Design Standards. This report intends to provide a basis for EPCOR French Creek to review the various options for upgrading the water system for both domestic and fire supplies as a result of future potential development based on the RDN's official community plan and existing zoning. The scope of the master plan includes:

- Review of OCP projections
- Review of the latest French Creek Master Plan Update
- Required system upgrades for planned developments
- Required system upgrade for current developments
- Existing water system model review
- Service and bulk meter data review
- Capital plan update, list developed with EPCOR
- Recommended improvements and conceptual capital cost.

The community of French Creek is located within the Regional District of Nanaimo's (RDN) Electoral Area "G". French Creek is centered between the Town of Qualicum Beach to the West, the City of Parksville to the South East, and the Strait of Georgia to the North. In May 2006, the French Creek water system assets of Breakwater Enterprises Ltd were transferred to EPCOR. EPCOR continues to operate and manage all aspects of the water system.

In addition to the above, we further assess the water system using demand projections for the 3-year, 10-year, and 20-year outlooks including increased density potential for any undeveloped property zoned for either multifamily or commercial developments. Within the French Creek existing water system industrial zoning is limited, Springhill Road and the Church Road area contain industrial zoned development potential which carries a fire flow of 225L/s under MMCD guidelines.

The number of customers serviced by EPCOR is expected to steadily increase as the population of French Creek grows. Based on the 2021 Census 7.7% growth rate over the last 5 years, the projected annual growth rate is approximately 1.2%.

Population Projections

Year	Growth Rate	Population
2023 Existing	1.2%	5026
2026 (3 Year)		5209
2033 (10 Year)		5663
2043 (20 Year)		6380

In order to develop an appropriate Maximum Daily Demand (MDD) flow we referenced the historical data between the years 2009 and 2022. The following data was collected by and provided by EPCOR.

Summary of Historic MDD

Year	MDD		Date
	MLD	L/s	Month - Day
2009	3.8	44.4	Jul-02
2010	3.7	42.3	Aug-12
2011	3.4	39.0	Aug-04
2012	3.6	41.8	Aug-05
2013	4.0	45.9	Jul-26
2014	3.5	40.6	Jul-17
2015	3.7	42.9	Jul-03
2016[1]	3.2	37.1	Jul-29
2017	3.4	39.4	Aug-04
2018	3.6	41.8	Aug-10
2019	3.4	39.4	Aug-14
2020	3.2	37.2	Jul-19
2021	4.0	45.9	Jun-27
2022	3.5	40.3	Jul-29
2023	3.5	40.7	Jul-02

The projected MDD was calculated with the assumption that the demand would increase at the same rate as the population - 1.2% growth rate.

MDD Forecast Using 2023 Data Year	MDD's (L/s)	PHD (1.5 X MDD)
2023 (3 Year)	45.9	68.9
2026 (3 Year)	47.2	70.8
2033 (10 Year)	50.6	75.9
2043 (20 Year)	55.3	83.0

Using this information, we then developed projections for the 3-year, 10-year, and 20-year outlooks. The water system was analyzed using the active Bentley WaterCAD model updated to 2019 conditions and using the future projection scenarios. A new scenario could be developed to include the latest 2023 system demands and MDD values, though the new values are only slightly higher than the 2019 conditions and wouldn't have much effect on the model results.

The first 3-year outlook involved detailed review of fire flow, hydrant replacement programs, domestic water pressure improvements, water storage, supply wells, and known development assessments. Stantec's analysis of the system follows MMCD design guidelines and good engineering practice. The following list of improvements were developed in conjunction with EPCOR's input.

French Creek Water System 2023 - 2026 Opinion of Probable Cost				
Limits of Commission:				
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.				
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**
Projects Established with EPCOR				
Meter Replacement	Lump Sum	1	355,000	355,000
Well Rehabilitated (1 well per year)	Each	3	30,000	90,000
Decommission / Demolish the French Creek Pump House	Lump Sum	1	25,000	25,000
Well performance evaluation and optimization Study	Lump Sum	1	50,000	50,000
Church Road Complex: Radio modem upgrade work on Church Road wells	Lump Sum	1	35,000	35,000
Church Road Main Twinning under Island Highway Study	Lump Sum	1	30,000	30,000
Drew Road Complex: Reservoir Study (scoping/ design study on capacity and seismic stability study)	Lump Sum	1	50,000	50,000
Chlorine Analyzer Replacements	Lump Sum	5	10,400	52,000
Drew Road Complex PLC Replacement	Lump Sum	1	36,000	36,000
GIS System Implementation	Lump Sum	1	72,000	72,000
Projects Established as a Result of our Analysis to Improve Serviceability				
Booster Pump on Church Road* *	Lump Sum	1	600,00	600,000
Pressure Reducing Valves (Including bypass and isolation valves)	Each	2	400,000	800,000
			Sub-Total	**2,234,000**
			40% Contingency	**893,600**
			Total	**3,127,600**

The mid-term 10-year assessment goal was to review required improvements to the water system for the established growth potential for domestic flows and improve the fire supply to the various deficient areas determined under the existing system analysis.

Such items as new hydrants are considered complete with any new distribution piping or new services to be constructed to MMCD design standards.

Additional items unrelated to recommended upgrades for increasing pressure and supply, we developed this list with input from EPCOR.

French Creek Water System 2026 - 2033 Evaluation Opinion of Probable Cost				
Limits of Commission:				
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.				
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**
Projects Established with EPCOR				
R8 Well Treatment	Lump Sum	1	250,000	250,000
Close Auxiliary French Creek Well (Has not been used since 1997 is a liability risk. Removal of pump and old shack and filling in dug well)	Lump Sum	1	25,000	25,000
Leak detection study	Lump Sum	1	30,000	30,000
Church Road watermain exposed near Morningstar Creek (pipe bursting)	Lump Sum	1	100,000	100,000
System AC watermain replacement program	Meter	TBD		
Projects Established as a Result of our Analysis to Improve Serviceability				
Upgrade 100mm Watermain to 200mm: Lundine Lane*	Meter	200	450	90,000
Upgrade 150mm Watermain to 200mm: Ackerman Road Development*	Meter	60	450	27,000
Upgrade 200mm Watermain to 250mm: Old Island Highway	Meter	300	500	150,000
Install 400mm Watermain: Church Road Twinning	Meter	3580	700	2,506,000
Upgrade 200mm Watermain to 250mm: Riley Road	Meter	410	500	205,000
Upgrading 100mm Watermain to 150mm: Single Family Deficient Fire Flow*	Meter	2400	400	960,000
			Sub -Total	**4,343,000**
			40% Contingency	**1,737,200**
			Total	**6,080,200**

*Improvements to be completed during the 2024-2026 RRA Test Period.

The 20-year assessment includes suggested improvements for the remaining deficient serviceability issues and ultimate fire flow for the industrial areas serviced by the Church Road upper pressure zone. Further development of supply wells and capacity are not specifically quantified in each assessment but is a known issue throughout with EPCOR's direct involvement required when exploring new capacity sources.

French Creek Water System 2043 Evaluation Opinion of Probable Cost				
Limits of Commission:				
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.				
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**
Projects Established with EPCOR				
Groundwater Exploration (Exploratory Boreholes). Electrical Resistivity tomography (EMT) to map a portion of the aquifer and drilling boreholes.	Lump Sum	1	149,000	149,000
Re-drill wells	Each	9	250,000	2,250,000
Projects Established as a Result of our Analysis to Improve Serviceability				
Church Road Complex: Reservoir Expansion (adding panels to existing reservoir)	Lump Sum	1	337,500	337,500
Church Road Complex Fire Pump	Lump Sum	1	450,000	450,000
			Sub -Total	**3,186,500**
			40% Contingency	**1,274,600**
			Total	**4,461,100**

Abbreviations

AAD	Average Annual Demand
AC	Asbestos Cement
ADD	Average Daily Demand
BDD	Base Day Demand
CI	Cast Iron Water Main
CPCN	Certificate of Public Convenience and Necessity
DI	Ductile Iron Water Main
EPCOR	EPCOR Water (West) Inc.
HGL	Hydraulic Grade Line
ICI	Industrial, Commercial and Institutional
KWL	Kerr Wood Leidal Consulting Engineers
MDD	Max Day Demand (2 x ADD)
MMCD	Master Municipal Construction Document
OPC	Official Community Plan
PHD	Peak Hour Demand (1.5 x MDD)
PRV	Pressure Reducing Valve
RDN	Regional District of Nanaimo
Stantec	Stantec Consulting Ltd.
TDH	Total Dynamic Head
VFD	Variable Frequency Drive
WTP	Water Treatment Plant

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by EPCOR Water (West) Inc. (EPCOR) to provide the French Creek 2020 Water System Master Plan Update.

The community of French Creek is located within the Regional District of Nanaimo's (RDN) Electoral Area "G". French Creek is centered between the Town of Qualicum Beach to the West, the City of Parksville to the South East, and the Strait of Georgia to the North. In May 2006, the French Creek water system assets of Breakwater Enterprises Ltd were transferred to EPCOR. EPCOR continues to manage and operate and manage all aspects of the water system.

1.1 SCOPE OF WORK

This report intends to provide a basis for EPCOR French Creek to review the various options for upgrading the water system for both domestic and fire supplies as a result of future potential development based on the RDN's official community plan and existing zoning. The scope of the master plan includes:

- Review of OCP projections
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- Required system upgrade for current developments
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2.0 POPULATION AND GROWTH RATE ASSESSMENT

2.1 SYSTEM AND CUSTOMER DEMOGRAPHICS

The French Creek water system mainly consists of single-family detached dwellings, but also services a mix of ICI properties. Based on the population size and a population density of over 400 people per square kilometer, Statistics Canada classifies most of the French Creek area as an “Urban” area. Figure 1 shows the Census Program Data map of the French Creek area with coloured areas of population density above and below 400 people per square kilometer. Areas below 400 are considered rural areas in Statistics Canada’s analysis of Canada’s rural areas.

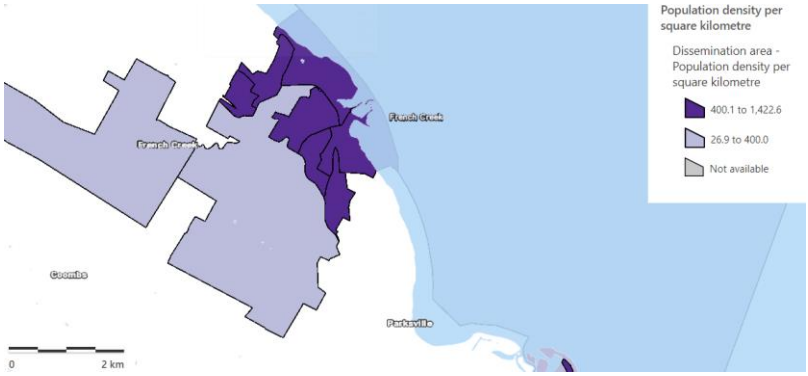

Figure 1 – French Creek Area Population Density, Statistics Canada 2021 Census

The 2021 Statistics Canada Census data for the French Creek Area, which includes the Electoral Areas of Nanaimo Area G and Area E, show an average household size of 2.2 persons with over 90% of dwellings being SF detached, semi-detached, row house and duplex. If the multi-family dwellings (apartments and moveable dwellings with a minimum of one occupant) are removed from the data, the average SFE dwelling household size increases to 2.3. Also, the 2021 Census data for the French Creek (unincorporated Place) Census area can be used for household and dwelling characteristics representative of a more rural area. The French Creek Census data shows a total of 500 occupied dwellings, with 480 being single-detached and semi-detached/row-house, which is 96% of all dwellings in the area. Based on this latest Census data for the region, an average household size in this region is estimated to be 2.3 persons/SFE dwelling.

2.2 GROWTH RATE CALCULATION

Based on a total of 2,185 active residential SFE connections, and a 2.3 person per connection estimate, we can estimate the 2023 population of the community of French Creek to be approximately 5,026 persons. The data used for the number of connections and establishing the per connection estimate is provided by EPCOR. Refer to the following table for the system’s estimated population and per capita demand over the last four (4) years.

Table 2-1 2019 Estimated Population and Per Capita Demand Unit Rates (1)

Year	Number of Active SFE[2]	Estimated Population[1]	ADD (lpcd)	MDD (lpcd)
2019	2131	4901	341	682
2020	2146	4936	311	652
2021	2181	5016	319	791
2022	2185	5026	317	693
4 Year Average			**322**	**704**

1. **Based on 2021 Regional Census Data of 2.3 people/SFE**
2. **EPCOR FC System 2022 Consumption Records**

The “Area G” Official Community Plan (OCP), adopted as Bylaw 1540 in 2008 (2), identified several areas for growth including French Creek, Harbour Centre and Wembley Centre. In order to accurately represent the community’s growth rate, we used historical data provided by EPCOR.

The number of customers serviced by EPCOR is expected to steadily increase as the population of French Creek grows. The number of customers serviced by EPCOR is expected to steadily increase as the population of French Creek grows. From the 2021 Census for the region, it was found that there was a 7.7% growth rate over the last 5 years. Using the growth rate over the last 5 years, the projected annual growth rate is approximately 1.2%. The following growth equation is used in the development of Table 2-2 Population Projections.

Population growth formula: $P = P_0(1 + r)^t$

P = Total Population
P_0 = Starting Population
r = % Rate Growth
t = Time in years

Table 2-2 Population Projections

Year	Growth Rate	Population
2023 Existing	1.2%	5026
2026 (3 Year)		5209
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2043 (20 Year)		6380

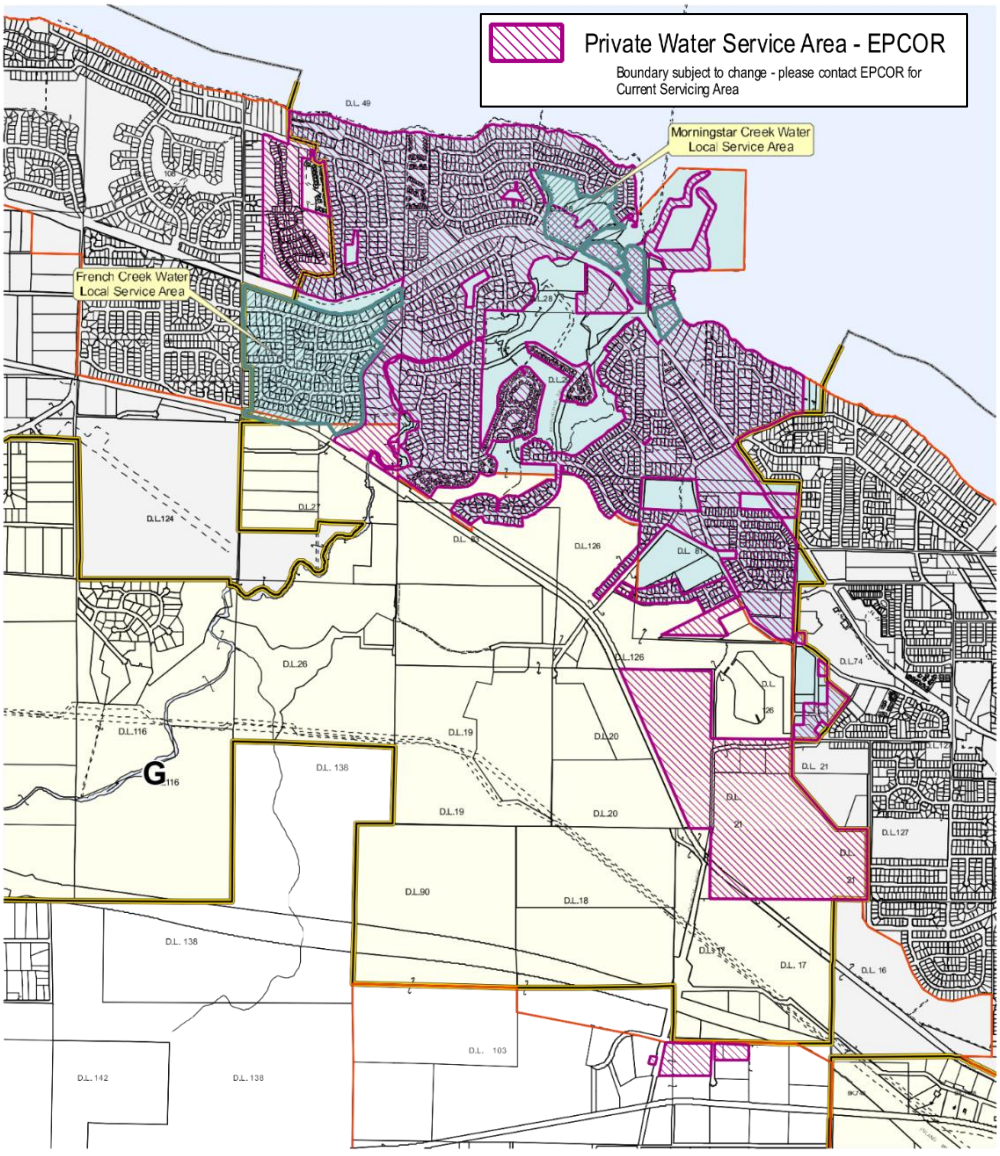


Figure 2-2 "Area G": French Creek Water Service Area (2)

3.0 WATER SYSTEM DESIGN CRITERIA

The conceptual design parameters used in this report were based upon a combination of the design guidelines of the MMCD – Design Guideline Manuals (3), Fire Underwriters Survey (FUS) and actual consumption data collected within the past 10 years. The parameter used for the basis of our evaluation is established as follows.

3.1 PER CAPITA DEMAND

Per capita demand is a way to look at a community's maximum daily demand and average daily demand by making the values relative to the community's population. In this way, it is useful to compare the water use of different communities. To find the per capita demand, the total annual water consumption for each year was used, along with the estimated population using the 2021 Census data. Table 2-1 shows the ADD and MDD per capita consumption from 2019-2022.

After review of the historical demands and recent Census data that Stantec and EPCOR have provided, the BC Water Utility Branch have recommended to use the highest recorded MDD of 791 lpcd in determining the current system MDD and for future service connections. The dwelling occupancy person per unit (ppu) values of 2.3 ppu for detached SFE dwellings and 1.4 ppu for multifamily dwellings should be used in determining the total water demand from future connections and developments. Refer to the report titled "EPCOR French Creek – Water System Demands and Design Standards Review" for further information on the water system demands and development of the system's design standards.

3.2 FIRE FLOW

When establishing fire flow for a development, MMCD Design Guidelines 2014 section 2.5 provides the following as a model; however, MMCD also identifies the use of the Fire Underwriters Survey in order to better refine the actual fire flow requirement. Each development is analyzed on a case by case basis to ensure adequate fire flows are provided.

Land Use Type	MMCD Design Guideline	Required Duration	Storage Volume
Single Family Residential minimum fire flow	60 L/s	1.4 hr	0.3 ML
Apartments, Townhouses	90 L/s	1.9 hr	0.6 ML
Institutional	150 L/s	2.0 hr	1.1 ML
Commercial	150 L/s	2.0 hr	1.1 ML
Industrial	225 L/s	2.0 hr	2.3 ML

3.3 HYDRANTS

Based on the MMCD Design Guidelines 2014 section 2.15 Hydrants

Residential Areas
Not more than 150m apart
Not more than 90m from a building

Additional fire hydrants may be required where fire flows exceed 90 L/s.

3.4 WATER PRESSURE

Based on the MMCD Design Guidelines 2014 section 2.7 Water Pressure, the following parameters were used within each of our assessments.

Design Parameter	MMCD Design Guideline
Maximum allowable system pressure	850 kPa (123 psi)
Maximum service connection pressure	515 kPa (75 psi)
Minimum pressure at Peak Hour Demand (PHD)	300 kPa (43 psi)
Minimum pressure in system during fire flow and Maximum Day Demand (MDD)	150 kPa (21 psi)

3.5 HYDRAULIC DESIGN

Based on the MMCD Design Guidelines 2014 section 2.8 Hydraulic Design, we reviewed the system for any exceedance of the following parameters.

Design Parameter	MMCD Design Guideline
Maximum allowable design velocity under peak hour flow conditions	2.0 m/s
Maximum design velocity under maximum daily demand plus fire flow	3.5 m/s

3.6 CAPACITY

3.6.1 Reservoir Capacity

Based on the MMCD Design Guidelines 2014 section 2.23.2 Capacity, reservoirs should be designed to suit the particular operating circumstances. Reservoir capacity is calculated by the following formula:

Total Storage Volume = A + B + C

A = Fire Storage
B = Equalization Storage (25% of Maximum Day Demand)
C = Emergency Storage (25% of A + B)

3.6.2 Well Capacity

Based on the MMCD Design Guidelines 2014 section 2.24.2 Capacity, the supply capacity for a water system must exceed the Maximum Daily Demand (MDD) to avoid water shortages during peak demands typically during summer months. In rating the supply capacity, it is normal practice to exclude the largest well

to provide a level of safety to deal with maintenance emergencies that may occur, this is defined as firm capacity.

4.0 EXISTING WATER SYSTEM (2019)

4.1 WATER SYSTEM DESCRIPTION

The French Creek water system, that is owned and operated by EPCOR, mainly comprises of single family residential with approximately 1834 single family residence connections, 300 multi-family unit connections, and 40 commercial connections. There are three pressure zones in the French Creek water system; the Main Pressure Zone, Church Road Booster Zone, and Mercer Point Reduced Pressure Zone. System pressurization is provided by both gravity and pumping from two reservoir sites.

The major supply facilities in the existing French Creek System include:

- 18 groundwater wells
- Drew Road Complex
  - Drew Road Water Treatment Plant (WTP)
  - Drew Road Reservoirs
  - Drew Road Pump Station
- Church Road Complex
  - Church Road Reservoirs
  - Church Road Pump Station

4.1.1 Main Pressure Zone (HGL = 79m)

Most of the water system users, approximately 96%, are located within the main pressure zone including all the groundwater supply wells. Two production sites deliver treated water to the main pressure zone, by gravity at Church Road and by pumping at Drew Road.

The Church Road site contains approximately 66% of the total storage capacity of the French Creek water system and 62% of the groundwater supply. Further specific details of storage volumes and groundwater supply can be found in chapters 4.6 and 4.7. Both domestic and fire supplies are delivered to the main pressure zone through a 300mm diameter transmission pipe travelling down Church Road to Wembley Road.

Drew Road treats and pumps both domestic and fire supplies to the main pressure zone through a 200mm diameter supply main. Drew Road's supply consists of the remaining 38% of the systems groundwater and 33% of the system storage. The pumping system uses up to three pumps to increase pressures throughout the lower main pressure zone areas.

4.1.2 Church Road Booster Zone (HGL = 168m)

The Church Road Booster Zone is located south of the Church Road Complex up to the Alberni Highway. The isolated upper pressure zone is supplied by a pump station at the Church Road reservoir which provides

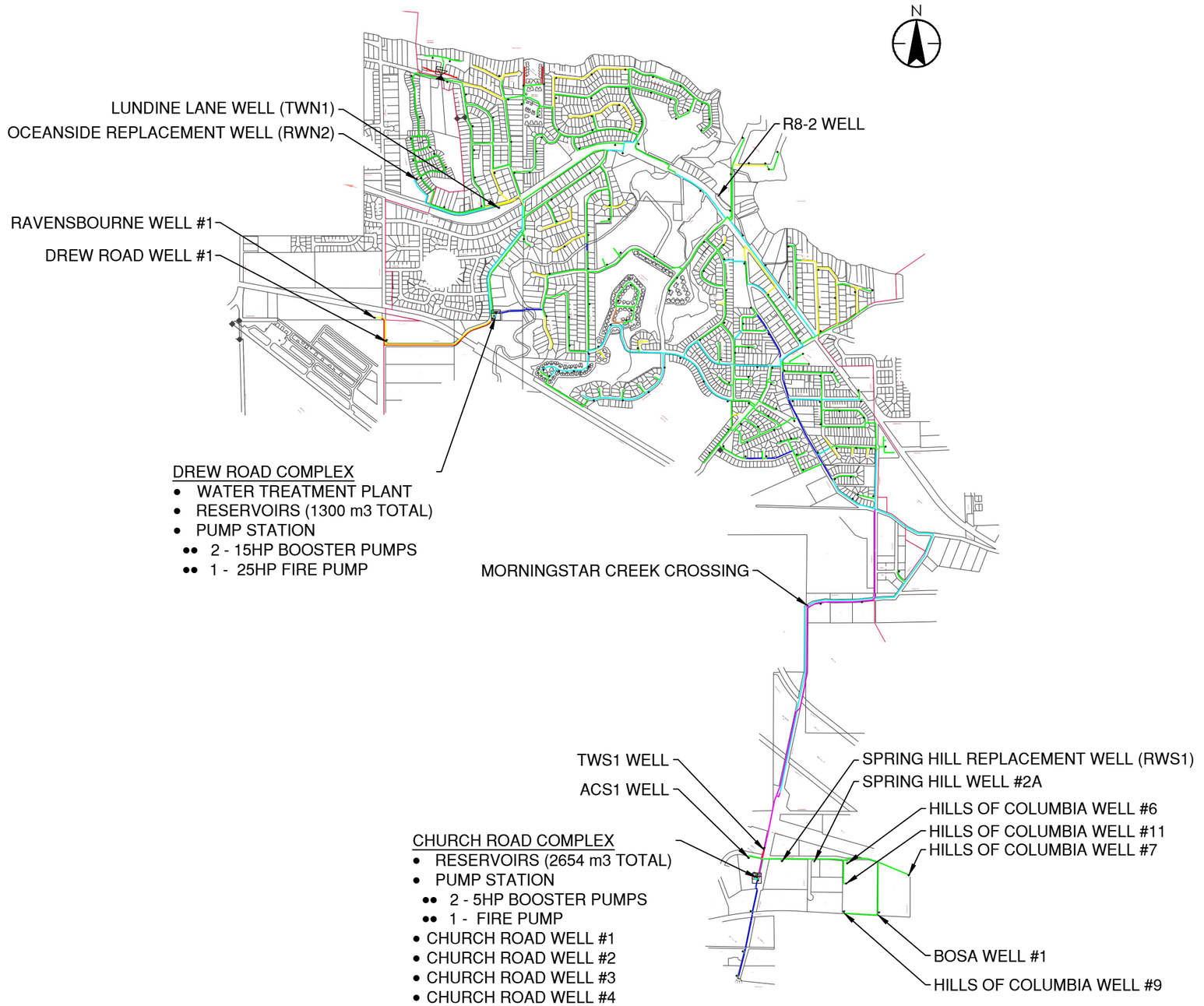
both domestic and fire protection. Using the same source and storage supply as described in the chapter above, treated water is pumped from the reservoirs by two booster pumps and balanced by a pressure tank. Fire protection to the upper zone is provided by a direct drive engine, horizontal fire pump which draws water directly from the existing reservoirs.

4.1.3 Mercer Point Zone (HGL = 68m)

Embedded in the main pressure zone is the Mercer Point reduced pressure zone. This small privately owned and operated system is pressure reduced at the property line of the development. This small system is located in the North East area of the main pressure zone. EPCOR's responsibility for the Mercer Point Zone ends at the Water Meter / Fire Valve at the property line.

WATERMAIN DIAMETER (mm)

- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø



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Client/Project

EPCOR WATER SERVICES

FRENCH BEACH WATER SYSTEM
MASTER PLAN UPDATE

Figure No.

4 - 1

Title

EXISTING WATER SYSTEM
(2019)

4.2 HISTORIC DATA

The following chapters contains the historical data used to establish our base MDD rate of 45.9 L/s. This is explained further in chapter 4.2.3.

4.2.1 Metered Water Usage Data

The data provided in the table below shows a summary of the monthly source flow totals for the metered water usage extracted from the Utilities Billing Database. The following data used in our assessments is collected and provided by EPCOR.

Table 4-1 Monthly Source Flow Totals (1)

Billing Period	Single Family		Multi-Family*		Commercial		Total	
	# of Meters	Usage (ML)	# of Meters	Usage (ML)	# of Meters	Usage (ML)	# of Meters	Usage (ML)
2017								
Jan 1- Mar 31	1,803	55	248	6	24	9	2,075	71
April 1- June 30	1,932	100	250	12	47	10	2,229	121
July 1-Sept 30	1,891	190	250	29	47	22	2,188	241
Oct 1- Dec 31	1,851	65	249	7	37	6	2,137	79
2017 Total		**410**		**54**		**48**		**512**
2018								
Jan 1- Mar 31	1,785	59	249	5	35	9	2,069	73
April 1- June 30	1,874	112	250	16	47	12	2,171	140
July 1-Sept 30	1,877	178	250	27	47	22	2,174	227
Oct 1- Dec 31	1,916	61	250	8	47	7	2,213	76
2018 Total		**410**		**56**		**50**		**516**
2019								
Jan 1- Mar 31	1,825	59	248	6	35	7	2,108	72
April 1- June 30	1,878	133	250	19	49	20	2,177	171
July 1-Sept 30	1,894	163	269	27	49	22	2,212	212
Oct 1- Dec 31	1,870	58	270	6	36	7	2,176	72
2019 Total		**413**		**58**		**56**		**527**
Current System	1608		506		43			
Current CPCN Approved	1834		300		40			

*Multi Family refers to an account type and not a dwelling with multiple families. The units presented represent single family units.

4.2.2 Existing Demand Summary

The existing demands for the current year 2022 are summarized in the table below. The table provides an overview of the latest recorded base demand and seasonal demand for each type of customer. The base day demand (BDD) is the average demand over the winter months (January, February and March) which corresponds to the metered billing period with the seasonal demand including irrigation use. The following data dissects how the MDD values are established and expanded further in chapter 4.2.2. The information is collected and provided by EPCOR.

Table 4-2 Year 2022 Demand Summary (1)

		Single Family Equivalent (SFE)	Industrial, Commercial and Institutional (ICI)	Total	Notes
	Number of Active Units	2,185	34	2,219	EPCOR Billing Records
Base Demand	Base Demand (ML)	74,166	9,284	83,450	Jan 1- March 31, 2022 meter usage
	Base Demand Rate (L/s)	9.54	1.19	10.7	
	Population			5026	Population Estimate is based on 2.3 capita per SFE
	Base Demand Rate (lpcd)	185			Jan 1- March 31, 2022 meter usage divided by population
Seasonal Demand	Estimated Irrigation Area (ha)	119	4.20	137	Based on 50% of 0.11ha lot area for SFE and 0.20ha lot area for ICI
	Seasonal Demand (L/s)	18.0	1.5	19.5	July 1st - September 30th, 2022 meter usage with base demand subtracted
Max Day	Max Day Consumption (L/s)	27.5	2.69	30.2	Base Demand plus Seasonal Demand
	MDD (L/s)	40.3			2022 Billing Records

4.2.3 Historical MDD Data

The following historical data is for all recorded years in the system from 2009 to 2022. The MDD represents the base demand and seasonal demand as defined in the previous section. The information is collected by and provided by EPCOR.

Table 4-3 Summary of Historic MDD (1)

Year	MDD		Date
	MLD	**L/s**	**Month - Day**
2009	3.8	44.4	Jul-02
2010	3.7	42.3	Aug-12
2011	3.4	39.0	Aug-04
2012	3.6	41.8	Aug-05
2013	4.0	45.9	Jul-26
2014	3.5	40.6	Jul-17
2015	3.7	42.9	Jul-03
2016[1]	3.2	37.1	Jul-29
2017	3.4	39.4	Aug-04
2018	3.6	41.8	Aug-10
2019	3.4	38.7	Aug-14
2020	3.2	37.2	Jul-19
2021[2]	4.0	45.9	Jun-27
2022	3.5	40.3	Jul-29
2023	3.5	40.7	Jul-02

1. **The number of days each week customers could water during watering restrictions changed from two days per week to every other day. This resulted in a decreased in the MDD, as water use was spread out throughout the week.**
2. **Recorded during the 2021 Western North America heat wave event.**

The highest value recorded over the last 14 years is 45.9 and represents an accurate worst case MDD consumption. This is value now being used as the current system MDD.

4.3 WATER MODEL (2019)

The following provides a synopsis of the water model's development since 2002 with Table 4-5 providing a detailed summary of the modifications Stantec completed on their active model.

Year	Notes
2002	Developed by Koers & Associates Engineering Ltd.
2008	Updated by KWL
2011	Updated by Stantec (WaterCAD model updated and used in the analysis for this report)
2014	Updated by KWL version 10.2.2.6 (file corrupt and unusable)
2019	Reverted to 2011 model because of corrupt and unusable file provided from KWL. Updated by Stantec version 10.02.02.06

Table 4-4 Water Model Updates (2019)

Drawing Number or Source	Updates
	Updated volume of Church Road Reservoirs to 2,654 m3
	Updated volume of Drew Road Reservoirs to 1,300 m3
	Changed pipe with "Ductile Iron" material type to material type "Unknown" with C Factor of 110
175-008	Nodes pipes adjusted to match current EPCOR French Creek Distribution System Plan
(4)	Add background layers from CAD provided by EPCOR
	Removed obsolete model scenario
1176-152-01	Size and material for watermain along Reid Road adjusted to 150mm diameter per EPCOR correspondence
L-722-02-02-07	No Change EPCOR unable to locate drawing: Confirmation of 200mm main on Wembley Rd between Crystal Court and Ackerman Rd to 250mm main requested.
L-722-02-02-07	No Change EPCOR unable to locate drawing: Confirmation of 200mm dia main and hydrant on Rd A and additional hydrant on Wembley Rd.
L-845-01-07-05	Added 200mm dia main and 2 hydrants on Wally's Way
120-03-2	38 Lot Subdivision: water model updated
120-03-12	Added 150 mm dia main and 3 hydrants on Road 1, Lowrys Rd, and Road 2
120-03-12	Changed material type of existing water main on Arrowsmith Way, Yellowbrick Road, and Lowery Rd from Ductile Iron to PVC
120-04-1 to 120-04-18	54 Lot Subdivision, 1032 Lowery
L-772-03-04-05	Added 200mm dia main and 3 hydrants on Sanika Close and Neden Way
120-02-1	Added 200mm dia main, 150mm dia main and 2 hydrants on Prospect Point Dr and Road 1
120-02-W1	20 Lot Subdivision: water model updated
190-02-1	No Change EPCOR unable to locate drawing: Confirmation of 50mm dia main on Wright Rd east of Ocean Pl.

Drawing Number or Source	Updates
218-01-1	EPCOR unable to locate drawing: Added 1 hydrant at 770 Woodland Dr from google maps.
206-01-1	Added 1 hydrant at north east side of intersection of Johnstone Rd and Old Island Highway
(4)	Added 150mm dia main and 1 hydrant on Emerald City Way per CAD provided by EPCOR
(4)	Added 150mm dia main, 100mm dia main and 5 hydrants for Lakes Blvd development per CAD provided by EPCOR
(4)	Revised alignment of 200mm dia main at the intersection of the Old Island Hwy and Columbia Dr per CAD provided by EPCOR
(4)	Added hydrant at the east end of Cavin Rd per CAD provided by EPCOR
	Updated diameters of pipe on Meadow Dr/ White Pine Way to 150mm diameter
(5)	Added Demands for: COOP (2.0 L/s) RDN Transfer Station (1.9 L/s) School District 69 Maintenance Building (4.0 L/s) Mechanical Shop (0.1 L/s)
	Updated diameter of Church Road Reservoir per information in 2011 Stantec Report /total volume at Church Rd is 2654 m3)
(6)	Updated Church Road Complex piping based off record drawings
	Revised well capacities per 'Model Bases Calculations' spreadsheet provided by EPCOR
269-01-1	504 Church Road: water model updated
257-01-2	745 Drew Road: water model updated
1176-152-01	808 Wembley: 150mm diameter PVC pipe confirmed
272-01-1	828 Reid Road: water model updated
1010-001-C02	833 Reid Road: water model updated
60848-01-D1	852 Woodland Drive: water model updated
263-01-1	853 Miller: water model updated
190-02-1A	863 Cavin Road: water model updated
3701-001-C02	1031 Robertson Place: water model updated
120-04-2	1032 Lowrys: water model updated
60931-01-D1	1316 Woodland Drive: water model updated
3517-C01	1371 Lundine Lane: water model updated
0292-01-01-B	1497 Mason Trail: water model updated
126-03-1 to 126-03-17	Esslinger Ackerman 20 Unit: water model updated
254-06-1	Lot H Johnstone Road: water model updated
39-010-2	Sumar Lane: water model updated
	Oceanside Well #2 not active and removed from model
	R8-2 Well added to model, but closed due to no flow per 'Model Bases Calculations'
	Springhill #2A Well added to model, but closed due to no flow per 'Model Bases Calculations'

Drawing Number or Source	Updates
	EPCOR unable to provide surface information: Fire Hydrant elevations updated based off Google Earth Pro elevation profile creation tool
	EPCOR unable to provide surface information: Node elevations updated based off Google Earth Pro elevation profile creation tool
1649-01	Drew Road Bypass and Pump Station Upgrade added to water model
3703-001-C01	2 lots (Lots 4 and 5, Remainder Lot B DL 81 Plan 44150): water model updated
	Pipe diameters adjusted to reflect ND
	Church Road Pump Curves: water model updated Pump 5HP = 4.39 L/s (pump head 51.1 m) Pump 5HP = 4.39 L/s (pump head 51.1 m) Fire Pump = 155 L/s (pump head 50.73 m)
	Drew Road Pump Curves: water model updated 2x15 HP: Aurora pump model 344 size 2x2.5x7A with 5.75-inch diameter impeller 1x25 HP: Goulds 25 HP pump Model#: 3756 S with size 2.5 X 3 - 7 impeller diameter 7.063
	Pump Curves for well pumps created based off elevations from Google Earth Pro and flows provided from EPCOR per ‘Model Bases Calculations’
	Created pressure zones in water model
	Assigned zones to nodes in water model
	PRV added for Mercer Point Zone. The valve station includes a single 150mm diameter PRV set to 80 psi
	Added MDD Existing scenario in water model
	Added MDD New Development scenario in water model
	Added Fire Flow scenario in water model
	Added PHD scenario in water model
	Added ACS1 well to model
	Added TWS1 well to model

4.4 FIRE FLOW (2020)

Using the active updated water model, we evaluated the fire flow potential throughout the system while under MDD and found several deficient areas. Fire flow water modeling results indicate that there are fire flow deficiencies for each of the exiting user types (Single Family less than 60 L/s, Multi-Family less than 90 L/s, Commercial less than 150 L/s and Industrial less than 225 L/s). Specific to the Single family fire flow requirement of 60 L/s, the following table in conjunction with figure 4-2 highlight these areas.

Table 4-5 Deficient Areas Less Than 60L/s

Item	Location	Description	Item	Location	Description
1	Neden Way	• Dead End • 200mm Pipe	13	Rockland Place	• Dead End
2	Mallard Road and Black Brant Road	• Dead End • 100mm Pipe	14	Crocus Corner	• Dead End • 100mm Pipe
3	Manse Road	• Dead End	15	River Crescent	• Dead End • 100mm Pipe
4	Admiral Tyron Boulevard	• 100mm Pipe	16	Fishermans Circle	• Dead End • 100mm Pipe
5	Marine Circle	• Dead End • 100mm Pipe	17	Pepper Place	• Dead End • 100mm Pipe
6	Windward Way, Oceanside Drive and Leeward Way		18	Old Island Highway	• 100mm Pipe
7	Marina	• Dead End • 100mm Pipe	19	Breakwater Road and Glenhole Crescent	• 100mm Pipe
8	Lee Road	• Dead End	20	Cavin Road	• Dead End • 100mm Pipe
9	Mason Trail	• Dead End • 100mm Pipe	21	Lowrys Road	• Dead End
10	Pacific Crescent	• Dead End • 100mm Pipe	22	Eagle Tree Close	• Dead End • 100mm Pipe
11	Wallys Way	• Dead End	23	Roberton Boulevard	• Dead End
12	Miller Road	• Dead End • 100mm Pipe	24	Windridge Place	• Dead End

Continuing to reference figure 4-2, each of the Multi-family areas shaded in light green, the Commercial areas shaded in blue, and the Industrial areas, adjacent to the Church Road reservoir, are all fire flow deficient. The figure also identifies how much fire flow is available to each area node while under MDD. The available fire flows within the Main Pressure Zone range from 90 to 120L/s adjacent to the deficient areas.

In order to meet or exceed the minimum fire flow parameters within these deficient areas, the recommended improvements are developed and summarized within Chapter 7 under the 10-year system assessment.

WATERMAIN DIAMETER (mm)

- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

FIRE FLOW AVAILABLE (L/S)

- <60
- 60 - 89
- 90 - 149
- 150 - 224
- > 225

ZONES

- SINGLE FAMILY RESIDENTIAL (60 L/s)
- MULTI-FAMILY RESIDENTIAL (90 L/s)
- COMMERCIAL (150L/s)
- INDUSTRIAL (225 L/s)

DREW ROAD COMPLEX

MATCH LINE

MATCH LINE

CHURCH ROAD COMPLEX

N

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\\CAN299-PPFSS01\workgroup\111720007\task_216_water_model_update\Drawings\Existing_Water_System.dwg Feb. 11, 20 OFITZGERALD

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AVAILABLE FIRE FLOW
(2020)

4.5 WATER PRESSURE AND MDD

4.5.1 Water Pressure

The following figures show the pressure during a PHD and MDD event for the existing system. Modeling indicates that there are existing PHD and MDD pressure deficiencies (less than 43 psi) as well as many areas exceeding the maximum allowable pressure (greater than 75 psi). Each of the deficient areas are circled in red and labeled highlighting the extent of the deficient area.

In order to correct the minimum pressure areas, we have provided recommendations within the following Chapter 5 which identify the use of localized booster pumping. Over pressure management is developed within the 20-year plan in Chapter 7, this includes the introduction of a new lower pressure zone using large pressure reducing valves and closing specific line valves.

4.5.2 MDD and PHD Forecast Using the Established Growth Rate and Historical MDD

The highest value recorded MDD over the last 14 years is 45.9, which occurred in 2013 and 2021, and represents an accurate worst case MDD consumption. This is value now being used as the current system MDD. The projected MDD was calculated with the assumption that the demand would increase at the same rate as the population. Refer to section 2.2 for the population projections and how the growth rate is established as 1.2%.

Table 4-6 below summarizes the resulting flow demand using the established MDD and growth rate projections for each of our study periods. Supplementing the MDD calculation is the PHD calculation which is found to be 1.5 X MDD, this standard is a derivative of the MMCD Design Guidelines 2014 section 2.3.

Table 4-6 MDD Forecast Using 2023 Data

Year	MDD's (L/s)	PHD (1.5 X MDD)
2023 (3 Year)	45.9	68.9
2026 (3 Year)	47.2	70.8
2033 (10 Year)	50.6	75.9
2043 (20 Year)	55.3	83.0

Supplementing the data above is EPCOR's peak instantaneous flow measured at <95L/s which occurs during dry summer months when residences are allowed to irrigate every other day. The instantaneous demand flow is reported to occur sporadically throughout the months of July and August only during irrigation days.

WATERMAIN DIAMETER (mm)

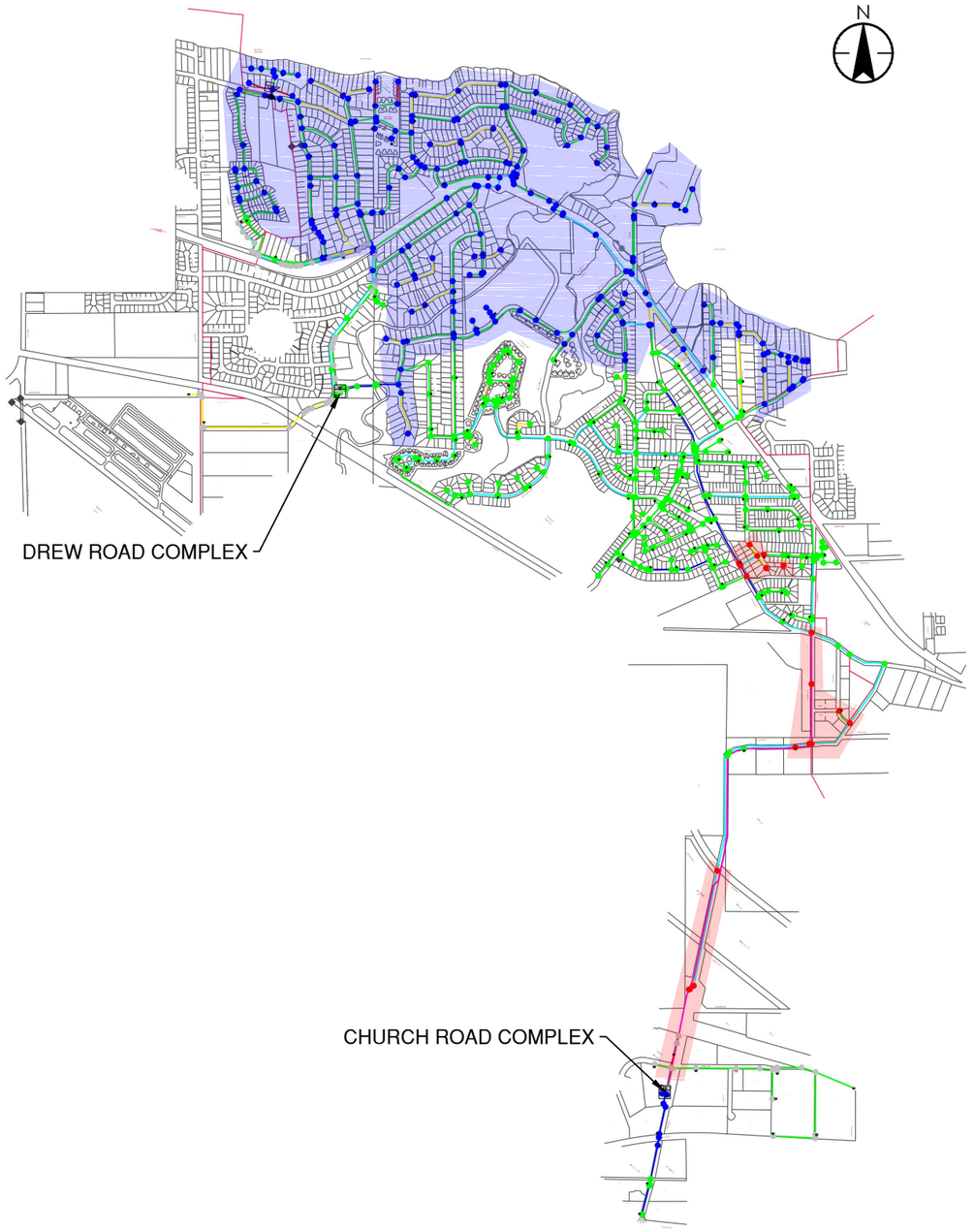
- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

PEAK HOUR PRESSURE (PSI)

- <43
- 43.1 - 75.0
- 75.1 - 123
- > 123

ZONES

- HIGH PRESSURE AREA (OVER 75 PSI)
- LOW PRESSURE AREA (UNDER 43 PSI)



FLOW DEMANDED: 63.3 L/S

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PEAK HOUR DEMAND
(2020)

WATERMAIN DIAMETER (mm)

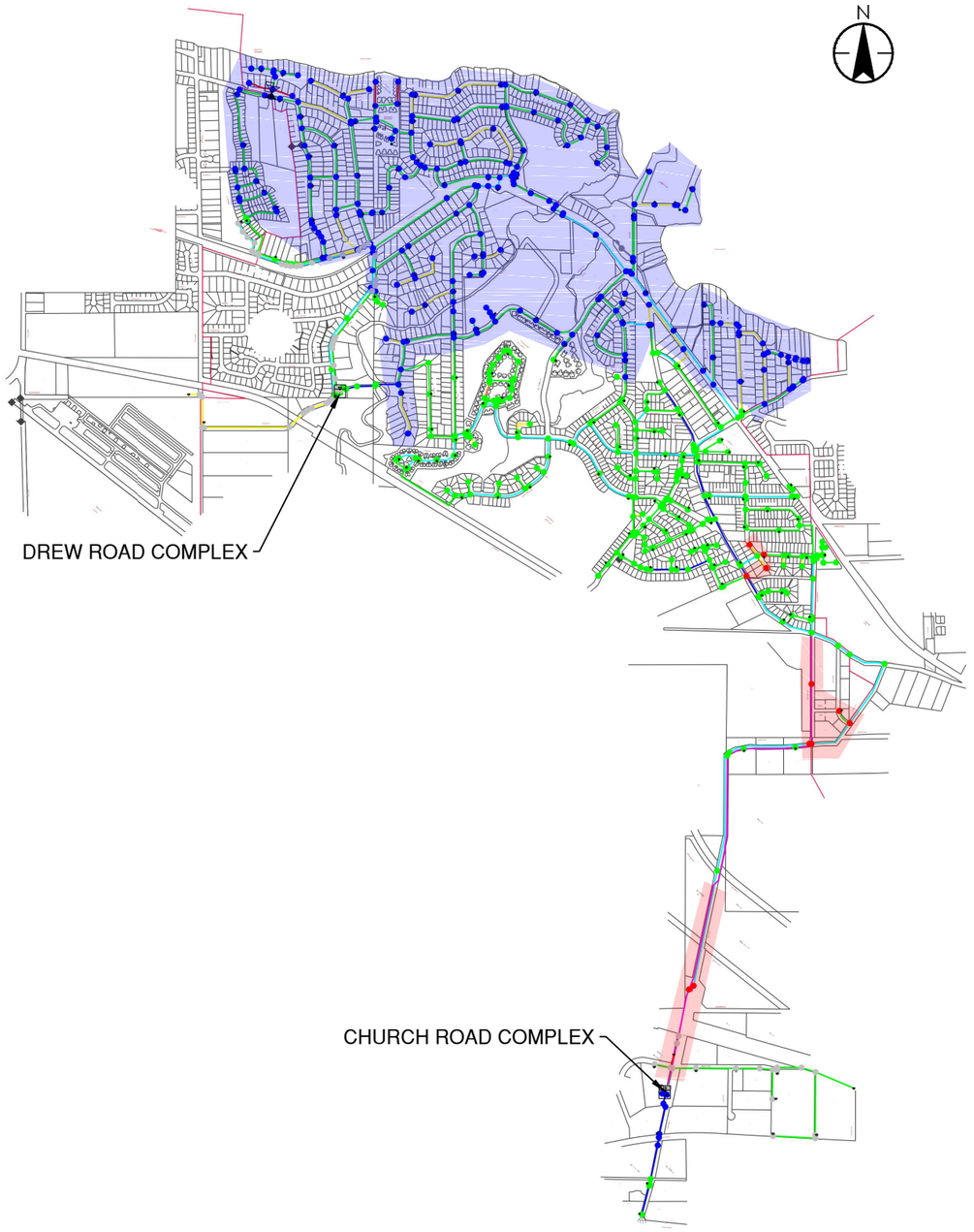
- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

PEAK HOUR PRESSURE (PSI)

- <43
- 43.1 - 75.0
- 75.1 - 123
- > 123

ZONES

- HIGH PRESSURE AREA (OVER 75 PSI)
- LOW PRESSURE AREA (UNDER 43 PSI)



FLOW DEMANDED: 42.2 L/S

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MAX DAY DEMAND
(2020)

4.6 STORAGE CAPACITY (2023)

Required storage capacity has been calculated according to MMCD design criteria as a guideline, as described in the Water System Design Criteria section. The MDD used in the calculations is referenced from Table 2-2. An assessment of the condition of the existing reservoirs is outside the scope of this report.

Table 4-7 Storage Assessment (2023)

Storage Capacity (2023)			
	Flow (L/s)	**Duration (hrs)**	**Storage Required (m^3)**
A. Required Fire Flow	150	2.0	$\frac{150\ L}{1\ s} \times \frac{1\ m^3}{1000\ L} \times \frac{3600\ s}{1\ hr} \times 2.0\ hr$ = 1080
B. Maximum Daily Demand (Equalization Storage 25% MDD)	45.9	24	$\frac{42.2\ L}{1\ s} \times \frac{1\ m^3}{1000\ L} \times \frac{3600\ s}{1\ hr} \times 24.0\ hr\ x\ 25\%$ = 992
C. Emergency Storage (Storage 25% of A +B)	-	-	$(1080\ m^3 + 992\ m^3) \times 25\%$ = 518
Total Required Storage (A + B + C)	-	-	$1080\ m^3 + 912\ m^3 + 498\ m^3$ = 2590
Available Storage Capacity (2023)			
Church Road Reservoirs	2654 m^3		
Drew Road Reservoirs	1300 m^3		
Total Available Storage	3954 m^3		
Deficiency (Total Available – Total Required)	$3954\ m^3 - 2590\ m^3 =$ **$1364\ m^3$** **No Deficiency**		

Given our findings above, the existing system does not need additional capacity to meet the emergency, fire, and balance storage requirement.

4.7 WELL CAPACITY (2023)

The French Creek water system is currently supplied by 18 groundwater wells. With the exception Well R8-2, all the wells pump to either the Drew Road Reservoirs or the Church Road Reservoirs with well R8-2 pumping directly to the distribution system.

The following analysis is based from the MMCD Design Guidelines 2014 section 2.24.2 - Capacity. The supply capacity for a water system must exceed the MDD to avoid water shortages during peak demands typically during summer months.

The following table represents the supply from the wells vs. the MDD calculations. Well status and flow data are provided by EPCOR and represents typical summer flow field conditions.

Table 4-8 Groundwater Wells (2023)

North Wells	Well ID	Peak Operating Rate (14 Day Max)* (L/s)	Notes
Lundine Lane Well (TWN1)	22514	1.5	
Oceanside Replacement Well (RWN2)	22525	13	RWn2 is planned to be twinned in 2024 with source water approval by 2026. The twinned well is intended to provide redundancy in the event of RWn2 is out of service during a MDD or high demand event.
Drew Rd Well #1	13803	4.0	
Ravensbourne Well	13804	5.5	
R8-2 Well	13808	3.0	Would be turned on when approaching MDD with largest well (RWN2) out of service. Groundwater well feeds directly into water main after addition of chlorine
South Wells	**Well ID**		
Church Road Well #1	13791	2.0	
Church Road Well #2	13792	2.0	
Church Road Well #3	13793	3.8	
Church Road Well #4	13794	1.5	
Springhill Replacement Well (RWS1)	22580	7.4	
Springhill #2A Well	13796	1.5	Would be turned on when approaching MDD with largest well (RWN2) out of service
Hills of Columbia Well #6A	13797	2.0	
Hills of Columbia Well #7	13798	2.1	
Hills of Columbia Well #9	13800	2.2	
Bosa Well	13799	4.0	
Hills of Columbia Well #11	13801	3.2	
ACS1	22600	8.3	Status: Recently approved and online
TWS1	22550	1.6	Status: Will be online shortly
Closed Wells			
Imperial Well	**-**	-	Decommissioned 2019
Lornedun Well	**-**	-	Decommissioned 2019
Total Capacity (All Wells)		**68.6**	
Capacity with the largest well out of service		**55.6**	

*Table A3 Summary of the Ground Water License Application Volumes and Peak Operating Rates for Active Water Supply Wells - Waterline Resources Inc. Report: Water Supply Investigation – EPCOR French Creek Utility, Parksville, BC, dated August 21, 2023.

Table 4-9 Groundwater Wells Capacity

Year	MDD	Supply Capacity of Groundwater Wells – MDD = Flow Difference
2023	**[45.9 L/s]** Actual Consumption based of field data	55.6 – 45.9 = 9.7 **L/s**
The following assumptions were made when calculating the well capacity: • MDD demand is derived from using actual field consumption data provided by EPCOR and distributed into the active existing water model.		

The above calculation identifies the existing system, when referencing MMCD firm capacity calculations, to be in surplus by 9.7 L/s. As the surplus capacity is in close proximity to the total available supply, exploring new supply sources is recommended and further expanded in chapter 5.

5.0 THREE YEAR ASSESSMENT (2026)

The 3-year assessment identifies immediate known projects through collaboration with EPCOR. The projects are a continuation of existing programs in place, assessments to further determine condition or ability of existing infrastructure, and continuation of system improvement programs.

The analysis includes recommendations for fire flow, hydrant replacement programs, domestic water pressure improvements, storage, well, and know development assessments. Finally, each of the recommended projects and their associated opinion of probable cost is listed in section 5.8.

Each analysis section (if applicable) references the 2026 MDD and PHD flow rates as generated above in Table 2-2.

5.1 FIRE FLOW (2026)

The immediate 3-year outlook recommends the system continue to operate under its existing fire flow plus MDD condition including know deficiencies. The following Chapter 6 provides our recommendations for improving the deficient Multi-family and Commercial fire flow areas to meet or exceed MMCD design parameters. The 20-year plan provides recommendations for providing minimum fire flow for the zoned Industrial areas near the Church Road reservoir and Springhill Road.

5.2 HYDRANTS (2026)

Hydrant spacing throughout the system was reviewed in a previous Stantec report for compliance to MMCD design guidelines which state maximum hydrant spacing is 150m with a maximum distance from a building of 90m of hose laying length (unobstructed distance). The 2011 Stantec report indicated that 47 additional hydrants were required. Since then, additional hydrants have been installed as new developments or redevelopment occurred. There are still areas that do not meet the design criteria for hydrant spacing.

To improve fire protection in the existing system, an annual hydrant installation program was established. Currently four fire hydrants are scheduled to be installed in 2020. Beyond 2020, two fire hydrants will be installed annually. The current list of fire hydrants to be installed are listed on the following page.

Table 5-1 Locations Requiring Fire Hydrant Installations

Fire Hydrants		
Location	**Pipe Diameter (mm)**	**Required Hydrants**
559 - 575 Johnstone Road	150	1
790 Barclay Crescent South	150	1
839 Woodland Drive	150	1
1212 Lee Road	150	1
1327 Lee Road West	150	1
Riley Road (923 Kasba Circle Back Side)	150	1
1373 - 1383 Pintail Drive	100	1
1576 Admiral Tryon	100	1
1518 Sunrise Drive	150	1

As of the writing of this 2023 update, all the above hydrants have been installed and this system deficiency has now been addressed.

5.3 DOMESTIC WATER PRESSURE (2026)

Building on the PHD analysis of the existing system, the Wembley area is a known deficient area during MDD and PHD scenarios. In order to increase service pressures within the immediate area we recommend a domestic booster station is constructed on Church Road. This station will boost the immediate area when the pressure falls below minimum criteria using a series of smaller continuous duty jockey pumps. It was determined that the existing Church Road reservoir stie would be the best spot for adding the booster pumps. The pumps would provide the MDD and PHD flows, while the outflow from the reservoirs would bypass the pumps to provide fire flows.

Most of the water system customers, approximately 96%, are located within the main pressure zone, including all groundwater supply wells. The water model shows PHD pressures as low as 36.6 psi in some areas and as high as 105.5 psi in others. The highest recorded Church Road reservoir outflow taken from June 27, 2021 is approximately 70 L/s. This peak flow from Church Road was used to size the booster pumps to be added at the reservoir pump station. Modeling of the maximum flows show the lowest pressures are 34 psi at Ackerman Road and Cannon Road. The model was then modified to include the Church Road booster pumps with an increased HGL of the main pressure zone to 88 m. The pump addition raised the low-pressure areas up to approximately 50 psi during PHD. The high-pressure areas with the revised HGL set at 88 m were verified during lower consumption periods. The pressure was found to increase to 117.5 psi for the area around the R8-2 compared to actual pressure of 104 psi with the original 79 m HGL. The other area checked for high pressures was on Dalmatian Drive next to the pebble Beach Development. The model showed an increase in pressure from 108.7 psi to 122.0 psi for this area with the boosted HGL. The following figure shows the pressure changes seen in the model with the increased HGL.

WATERMAIN DIAMETER (mm)

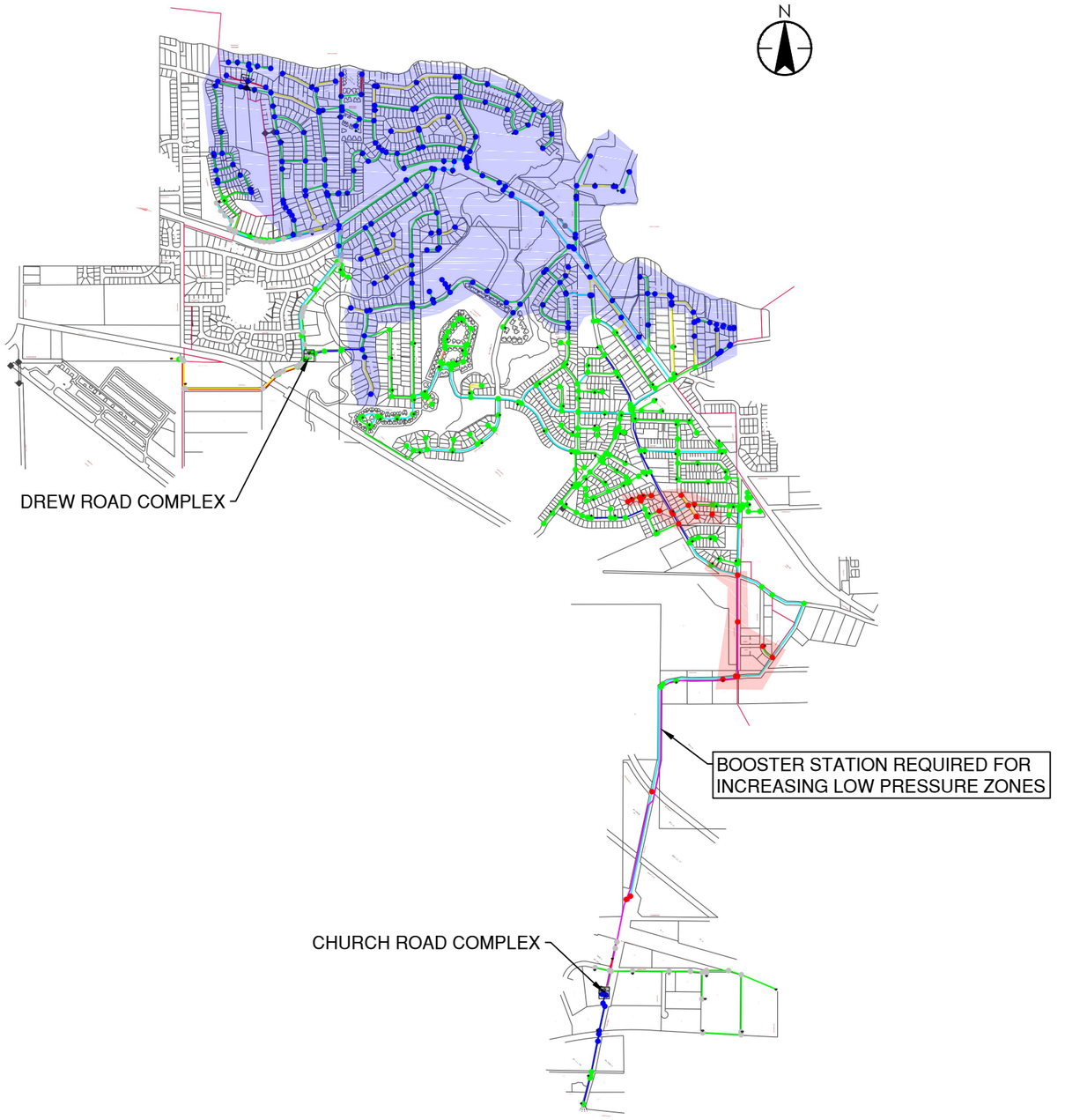
- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

PEAK HOUR PRESSURE (PSI)

- <43
- 43.1 - 75.0
- 75.1 - 123
- > 123

ZONES

- HIGH PRESSURE AREA (OVER 75 PSI)
- LOW PRESSURE AREA (UNDER 43 PSI)



FLOW DEMANDED: 65.6 L/S

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PEAK HOUR DEMAND
(2023)

5.4 STORAGE CAPACITY (2026)

The MDD used in the calculations is referenced from Table 2-2. An assessment of the condition of the existing reservoirs is outside the scope of this report.

Table 5-2 Storage Assessment (2026)

Storage Capacity (2023 - Projected) (For Projected Data Refer to section 2.2 Growth Rate Calculation)			
	Flow (L/s)	**Duration (hrs)**	**Storage Required (m^3)**
A. Required Fire Flow	150	2.0	= 1080
B. Maximum Daily Demand (Equalization Storage 25% MDD)	47.2	24	= 1020
C. Emergency Storage (Storage 25% of A +B)	-	-	= 525
Total Required Storage (A + B + C)	-	-	= 2625
Available Storage Capacity (2023)			
Church Road Reservoirs	2654 m^3		
Drew Road Reservoirs	1300 m^3		
Total Available Storage	3954 m^3		
Deficiency (Total Available – Total Required)	$3954\ m^3 - 2625\ m^3 =$ $\mathbf{1424\ m^3}$ **No Deficiency**		

Given our findings above, the system does not need additional capacity to meet the emergency, fire, and balance storage requirement for the 3-year outlook.

5.5 WELL CAPACITY (2023)

The following table represents the known supply from the wells and the extrapolated 2023 MDD value.

Table 5-3 Groundwater Wells Capacity

Year	**MDD**	**Supply Capacity of Groundwater Wells – MDD = Flow Difference**
2026	**[47.2 L/s]** Projected Consumption (For Projected Data Refer to section 2.2 Growth Rate Calculation)	55.6 – 47.2 = **8.4 L/s**
The following assumptions were made when calculating the well capacity: • Existing Supply Capacity of Ground Water Wells [55.6 L/s] calculated in section 4.7 Well Capacity • MDD demand is derived with the assumption that the demand would increase at the same rate as the population.		

As noted in section 4.7 and the above calculation identifies the system to be in surplus, when referencing MMCD firm capacity calculations. As the surplus capacity is in close proximity to the total available supply, exploring new supply sources is required. EPCOR is currently investigating potential for a bulk water

connection with the RDN. The potential additional supply capacity as a result of this connection is yet to be determined.

5.6 ACTIVE METER REPLACEMENT (2020)

There are 2,212 water meters in the EPCOR French Creek Water System according to the 2019 meter records provided by EPCOR. An annual meter replacement program is currently in progress where approximately 50 - 100 touch read meters are replaced each year. EPCOR staff have indicated that in approximately two years the meter replacement program will be complete and transition to a meter replacement for faulty meters only.

Meters have continued to function as they age; however, wear over time will cause them to under record resulting in loss of revenue. The optimum replacement age is dependent on local factors such as water chemistry, soil conditions and usage. According to the AWWA M6 "Water Meters - Selection, Installation, Testing, and Maintenance" manual, a water supplier should develop a meter replacement program based on testing of a representative sample of residential meters that establishes an accuracy versus age relationship. After the existing meter replacement plan is completed It is recommended to follow the industry standard, which is to replace meters on a 20-year cycle as well as replacing faulty meters as they appear.

5.7 POTENTIAL DEVELOPMENTS (2026)

Shown below is a list of the development applications within the next three years. These added capacity request and fire flow requirements are evaluated on a case by case scenario. Understanding extra capacity of the existing system is limited, these developments may be required to explore additional source capacity as part of their development application.

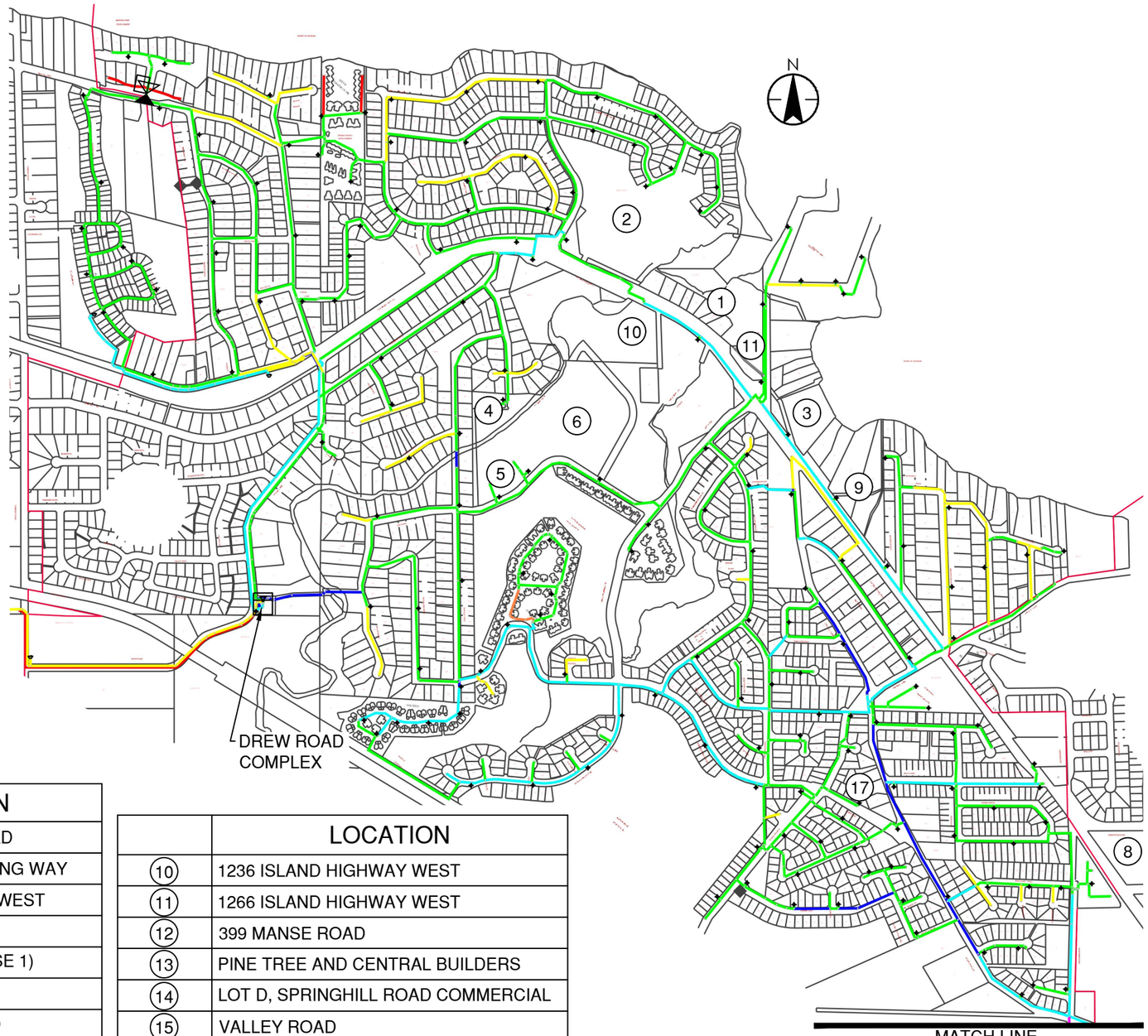
Table 5-4 Lot Count and Water System Demands (2023)

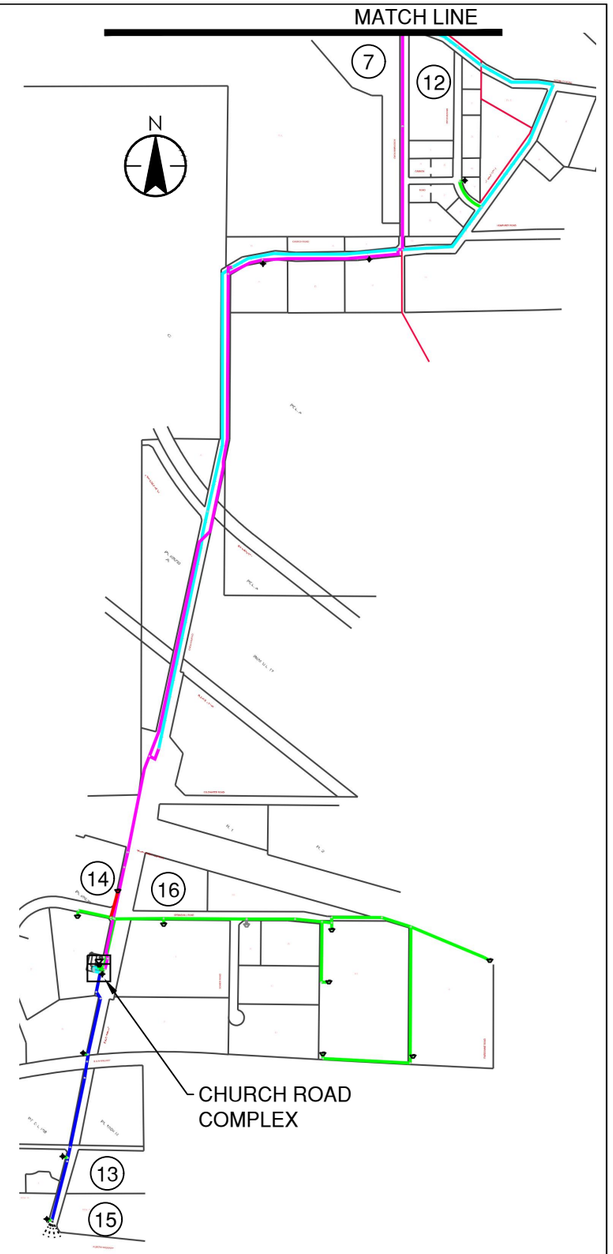
Location	Number of Units	MDD (L/s)	Notes
2023 Existing	2185	45.9	
2023 Approved CPCN SFE Connections	75	1.3	
		47.2	
1025 and 1035 Lee Road	166	-	Future
Columbia Drive/ Viking Way	80	-	Future
Lot G, Wembley Road	86	-	Future
1025 and 1035 Island Highway	51	-	Future
1236 Island Highway West	56	-	Future
1266 Island Highway West	33	-	Future
399 Manse Road – Multi Res	200	-	Future
Lot D, Springhill Road Commercial	-	-	Future
Valley Road	-	-	Future
Church Road Commercial	-	-	Future

The above identifies potential future demand of at least 12.6 L/s, with the existing system identified as in a surplus to 9.3 L/s, these assumed applications may be required to source additional well supply in order to meet their added capacity request.

WATERMAIN DIAMETER (mm)

- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø





	LOCATION
1	1025 AND 1035 LEE ROAD
2	COLUMBIA DRIVE / VIKING WAY
3	1055 ISLAND HIGHWAY WEST
4	LOT C, IMPERIAL DRIVE
5	LOT A, LEE ROAD (PHASE 1)
6	LOT A, LEE ROAD
7	LOT G, WEMBLEY ROAD
8	846 ISLAND HIGHWAY
9	1025 AND 1035 ISLAND HIGHWAY

	LOCATION
10	1236 ISLAND HIGHWAY WEST
11	1266 ISLAND HIGHWAY WEST
12	399 MANSE ROAD
13	PINE TREE AND CENTRAL BUILDERS
14	LOT D, SPRINGHILL ROAD COMMERCIAL
15	VALLEY ROAD
16	CHURCH ROAD COMMERCIAL
17	SHAVER

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MASTER PLAN UPDATE

Figure No.

5 - 2

Title

DEVELOPMENTS
(2023)

5.8 RECOMMENDED PROJECTS AND CONCEPTUAL OPINION OF PROBABLE COST (2026)

Given each analysis above we provide the following list of improvements and conceptual cost. For the listed items unrelated to the recommended serviceability upgrades, these were developed in conjunction with EPCOR for known required projects.

The final column within the opinion of probable cost labeled “Breakout” is intended to provide EPCOR with an understanding of how the improvement could be paid by either a developer or if the improvement is rate based.

How each payee is determined is based on if the improvement corrects an existing deficient condition or is required to facilitate a development. If the improvement is a combination of new development and rate based funding, we have provided our recommendation accordingly.

French Creek Water System 2023 - 2026 Opinion of Probable Cost
Items Not Included in Cost Estimate
1. Engineering design and further assessments 2. Geotechnical investigations 3. Environmental Impact studies and mitigation 4. Archeological encounters and mitigation 5. Owners Administration 6. Topographic Surveys
General Notes
1. Pipe lengths are estimated between pump and connection point 2. Opinion of probable costs are based on preliminary information only and conceptual evaluations and are subject to wide variation in quantity and cost 3. Costs are in 2020 Dollars
Limits of Commission:
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.

French Creek Water System 2023 - 2026 Opinion of Probable Cost					
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**	**Breakout[1]**
Projects Established with EPCOR					
Meter Replacement – Advanced Meter Reading Program (Replacing End of Life Meters with Smart Meters)	Lump Sum	1	355,000	355,000	RB = 100%
Well Rehabilitated (1 well per year)	Each	3	30,000	90,000	RB = 100%
Decommission / Demolish the French Creek Pump House	Lump Sum	1	25,000	25,000	RB = 100%
Well performance evaluation and optimization Study	Lump Sum	1	50,000	50,000	RB = 100%
Church Road Complex: Radio modem upgrade work on Church Road wells	Lump Sum	1	35,000	35,000	RB = 50%[2] D = 50%
Church Road Main Twinning under Island Highway Study	Lump Sum	1	30,000	30,000	RB = 100%
Drew Road Complex: Reservoir Study (scoping/ design study on capacity and seismic stability study)	Lump Sum	1	50,000	50,000	RB = 50%[3] D = 50%
Chlorine Analyzer Replacements	Lump Sum	5	10,400	52,000	RB = 100%
Drew Road Complex PLC Replacement	Lump Sum	1	36,000	36,000	D = 100%
GIS System Implementation*	Lump Sum	1	72,000	72,000	RB = 100%
Upgrade 150mm Watermain to 200mm: Ackerman Road Development	Meter	60	450	27,000	RB = 50% D = 50%
Upgrade 100mm Watermain to 200mm: Lundine Lane	Meter	200	450	90,000	RB = 50% D = 50%
Upgrading 100mm Watermain to 150mm: Single Family Deficient Fire Flow*	Meter	2400	400	960,000	RB = 50% D = 50%
Projects Established as a Result of our Analysis to Improve Serviceability					
Booster Pump on Church Road	Lump Sum	1	600,000	600,000	RB = 25% D = 75%[4]
Pressure Reducing Valves (Including bypass and isolation valves)	Each	2	400,000	800,000	RB = 25% D = 75%[3]
			Sub-Total	**3,272,000**	
			40% Contingency	**1,308,800**	
			Total	**4,580,800**	

*Project will be conducted in phases and will continue through the 2027-2029 test period.

1 Within the breakout column D = development funded and RB = rate based funded as a percentage.

2 The developer could benefit from this study by locating additional potential supply.

3 The system is known to be deficient in both fire flow and pressure with this improvement eliminating the reduced fire flow. The developer could benefit from this study and project as this would improve fire flow to the main pressure zone which the development could increase density.

4 The system is known to be deficient during elevated use domestic demand scenarios but the number of existing rate payers that will benefit from the Booster Pump system and elevated pressures is small. Based on communication with the landowners, there is significant development potential in the Wembley – Manse with approximately 200 multifamily units and 100 single family homes in the development planning/permitting process. These new and proposed developments show that the developers will benefit the most with the increase in pressures within the system.

6.0 TEN YEAR ASSESSMENT (2033)

The mid-term 10-year assessment goal is to review required improvements to the water system for the established growth potential for domestic flows as summarized in Table 2-2 and improve the fire supply to the various deficient areas determined under the existing system analysis.

Such items as new hydrants and metering programs are considered complete with any new distribution piping or new services to be constructed to MMCD design standards.

Additional items unrelated to recommend upgrades for increasing pressure and supply, we developed this list with input from EPCOR.

6.1 FIRE FLOW (2033)

In order to upgrade the system to meet MMCD specified fire flow and minimum pressure requirements to the Multi-family and Commercial deficient areas noted in Section 4.4, we propose twinning the Church Road transmission main and include a series of pipe loops or specific pipe diameter increases. These suggested improvements are as follows and shown schematically in the following figure:

Item	Type	Proposed Diameter (mm)	Description	Length (m)
1	Upgrade 100mm Watermain*	200	Lundine Lane (Transmission Pipe)	200
2	Upgrade 200mm Watermain	250	Riley Road	410
3	Upgrade 150mm Watermain*	200	Ackerman Road Development	60
4	Upgrade 200mm Watermain	250	Old Island Highway	300
5	Install Watermain	400	Church Road Twinning	3580

6	Upgrade 100mm and 150mm Watermain	250	Wembley Road	400

*Improvements 1 and 3 sre planned to be completed during the 2024-2026 period.

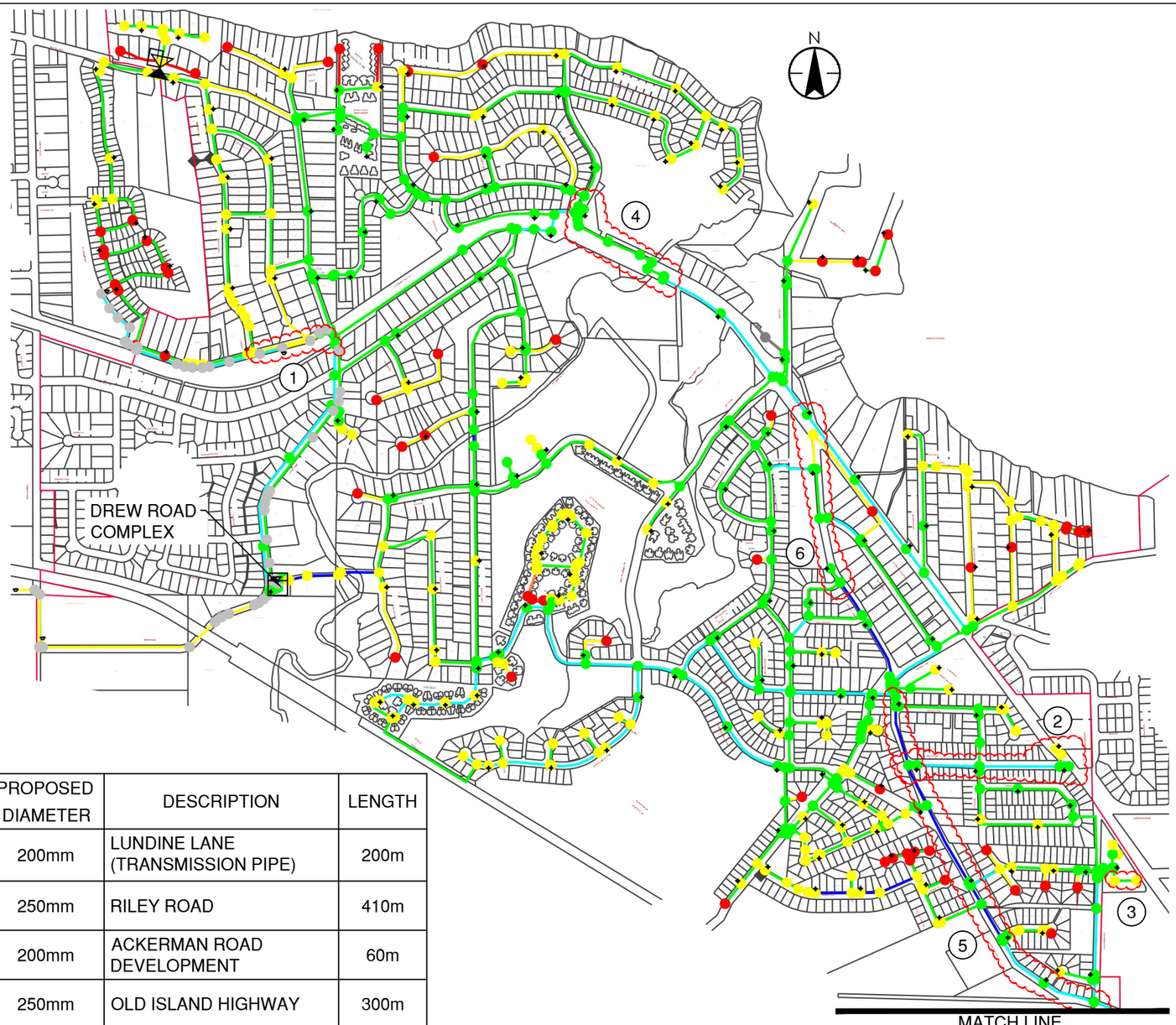
When evaluating the fire flow potential including the upgrades above and using the 2033 MDD we find the Multi-family areas shown in light green requiring 90 L/s and Commercial areas shown in blue requiring 150 L/s is now achievable including meeting minimum pressures. The following two figures provide the suggested upgrades and the resulting fire flow when including the upgrades.

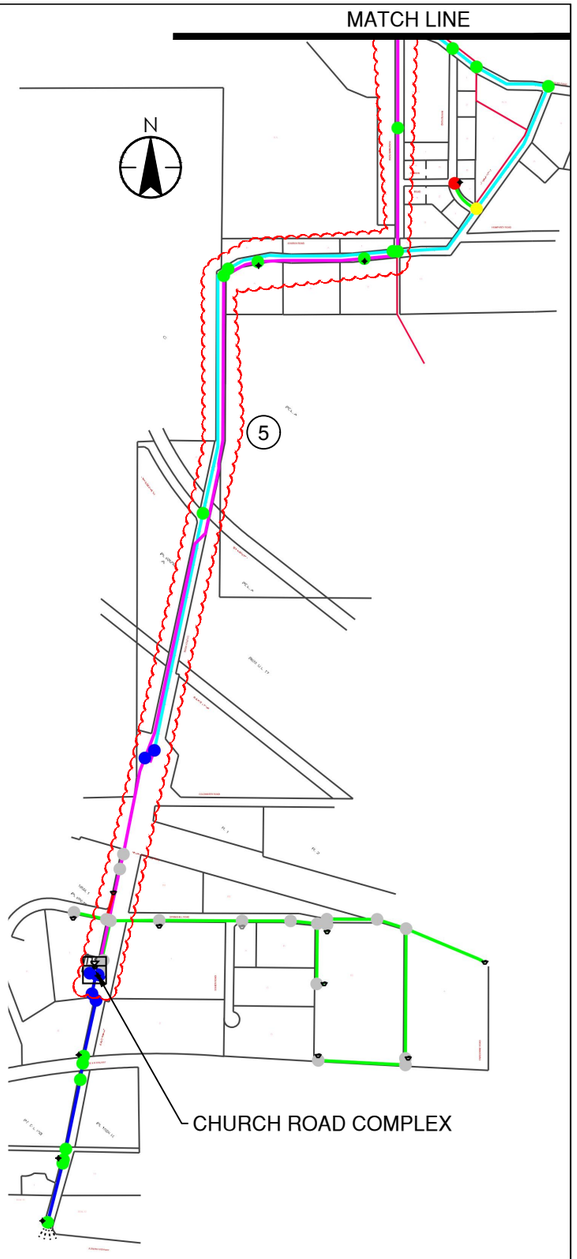
Each of the Single family deficient areas listed in Section 4.4 and Figure 4-2 includes dead ends and undersized piping. For each of these areas it is recommended an upgrade program is established however it is not as important as the system upgrades for the Multi-family and Commercial fire flow demands. Quantification of this upgrade is included as a total quantity of pipe for all 24 locations.

Industrial fire flows of 225 L/s within the Church Road / Springhill Road areas is evaluated within Chapter 7 under the 20-year plan.

WATERMAIN DIAMETER (mm)

- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø





ITEM	TYPE	PROPOSED DIAMETER	DESCRIPTION	LENGTH
1	UPGRADE 100mm WATERMAIN	200mm	LUNDINE LANE (TRANSMISSION PIPE)	200m
2	UPGRADE 200mm WATERMAIN	250mm	RILEY ROAD	410m
3	UPGRADE 150mm WATERMAIN	200mm	ACKERMAN ROAD DEVELOPMENT	60m
4	UPGRADE 200mm WATERMAIN	250mm	OLD ISLAND HIGHWAY	300m
5	INSTALL WATERMAIN	400mm	CHURCH ROAD TWINNING	3580m
6	UPGRADE 100mm and 150mm WATERMAIN	250mm	WEMBLEY ROAD	400m

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Figure No.
6 - 1

Title
UPGRADE AND INSTALL WATER MAIN (2030)

ZONES

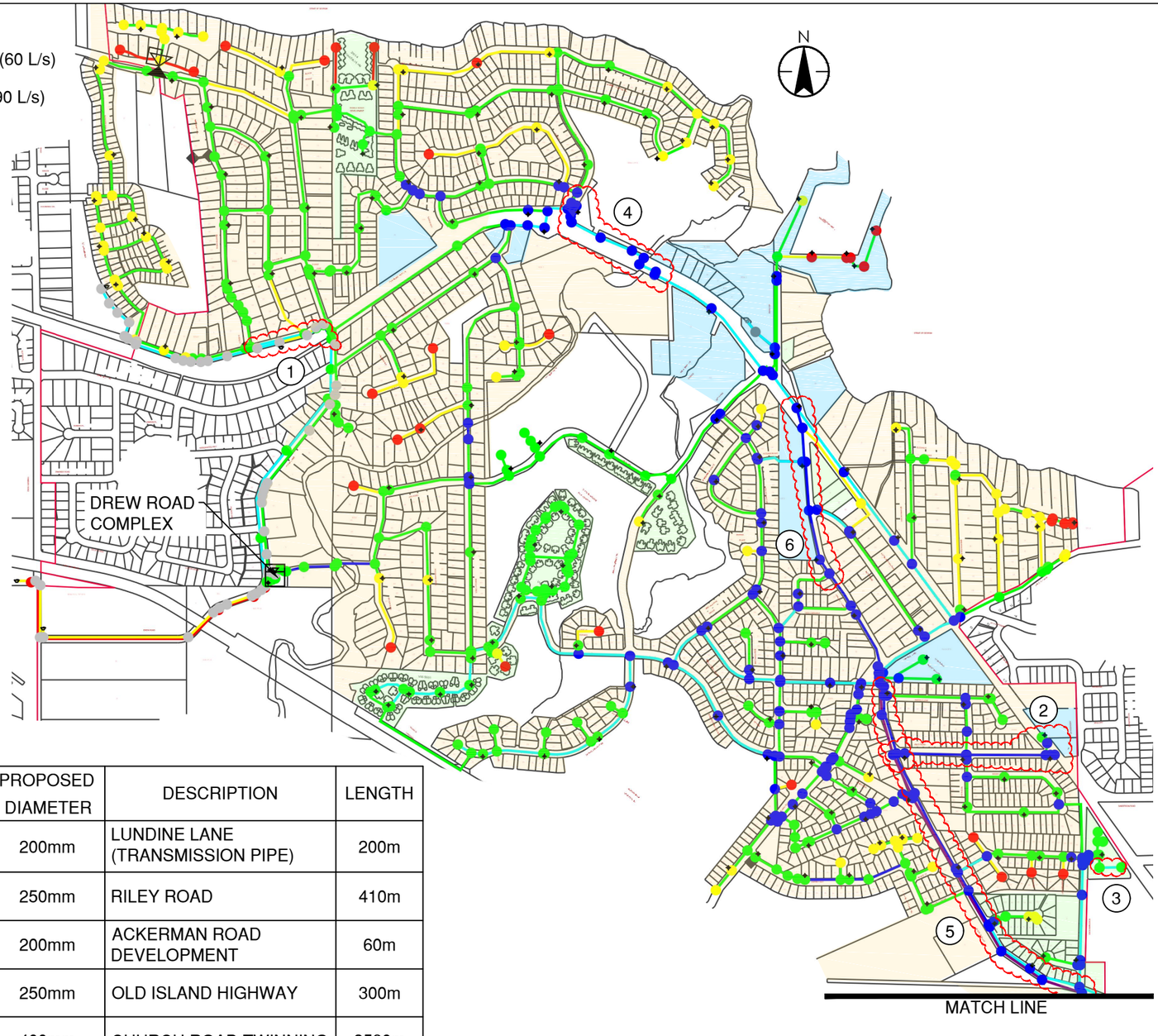
- SINGLE FAMILY RESIDENTIAL (60 L/s)
- MULTI-FAMILY RESIDENTIAL (90 L/s)
- COMMERCIAL (150L/s)
- INDUSTRIAL (225 L/s)

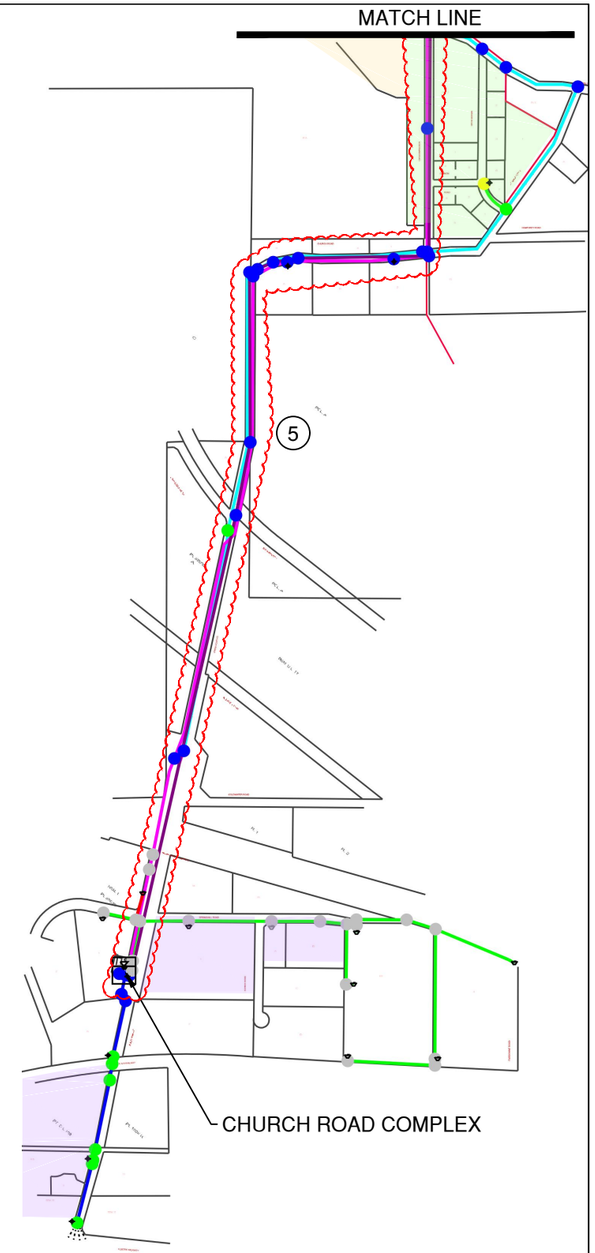
WATERMAIN DIAMETER (mm)

- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

FIRE FLOW AVAILABLE (L/S)

- <60
- 60 - 89
- 90 - 149
- 150 - 224
- > 225





ITEM	TYPE	PROPOSED DIAMETER	DESCRIPTION	LENGTH
1	UPGRADE 100mm WATERMAIN	200mm	LUNDINE LANE (TRANSMISSION PIPE)	200m
2	UPGRADE 200mm WATERMAIN	250mm	RILEY ROAD	410m
3	UPGRADE 150mm WATERMAIN	200mm	ACKERMAN ROAD DEVELOPMENT	60m
4	UPGRADE 200mm WATERMAIN	250mm	OLD ISLAND HIGHWAY	300m
5	INSTALL WATERMAIN	400mm	CHURCH ROAD TWINNING	3580m
6	UPGRADE 100mm and 150mm WATERMAIN	250mm	WEMBLEY ROAD	400m

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Title

FIRE FLOW WITH UPGRADED PIPES (2030)

Of the 6 improvements detailed within the figures and the above table, the most beneficial or important upgrades involve upsizing of the transmission main from Church Road reservoir to the core area of the water system. Improvements 5 - Church Road Twinning, 6 – Wembley Road, and 4 – Old Island Highway are interconnected and would prove as the most benefit to the system in transmitting the required fire flow to the deficient areas. The remaining secondary improvements including 1 – Lundine Lane, 2 – Riley Road, and 3 – Ackerman Road would use the supply water from the primary improvements to mitigate that local areas fire serviceability issue.

6.2 DOMESTIC WATER PRESSURE (2033)

When evaluating the minimum pressure for the 10-year design flows for both MDD and PHD scenarios, we find the system would not be able to provide the specified flow within minimum pressure requirements. The evaluation includes using the suggested Church Road Booster Station quoted in Chapter 5. To increase the flows to meet the future 2033 MDD and PHD flows, an additional (fourth) booster pump can be added to the initial three pump lineup at the Church Road Pump Station.

Over pressure management continues to be an issue with the suggested improvements provided in the subsequent 20-year plan in Chapter 7.

6.3 STORAGE CAPACITY (2033)

The MDD used in the calculations is referenced from Table 2-2. An assessment of the condition of the existing reservoirs is outside the scope of this report.

Table 6-1 Storage Assessment (2033)

Storage Capacity (2033 - Projected) (For Projected Data Refer to section 2.2 Growth Rate Calculation)			
	Flow (L/s)	**Duration (hrs)**	**Storage Required (m^3)**
A. Required Fire Flow	150	2.0	= 1080
B. Maximum Daily Demand (Equalization Storage 25% MDD)	46.6	24	= 1093
C. Emergency Storage (Storage 25% of A +B)	-	-	= 543
Total Required Storage (A + B + C)	-	-	= 2716
Available Storage Capacity (2023)			
Church Road Reservoirs	2654 m^3		
Drew Road Reservoirs	1300 m^3		
Total Available Storage	3954 m^3		
Deficiency (Total Available – Total Required)	$3954\ m^3 - 2716\ m^3 =$ **$1238\ m^3$** **No Deficiency**		

Given our findings above, the system does not need additional capacity to meet the emergency, fire, and balance storage requirement for the 10-year outlook.

6.4 WELL CAPACITY (2033)

The following table represents the known supply from the wells and the extrapolated 2030 MDD value.

Table 6-2 Groundwater Wells Capacity

Year	MDD	Supply Capacity of Groundwater Wells – MDD = Flow Difference
2033	**[50.6 L/s]** Projected Consumption (For Projected Data Refer to section 2.2 Growth Rate Calculation)	55.6 – 50.6 = **5.0 L/s**
The following assumptions were made when calculating the well capacity: • Existing Supply Capacity of Ground Water Wells [55.6 L/s] calculated in section 4.7 Well Capacity • MDD demand is derived with the assumption that the demand would increase at the same rate as the population.		

6.5 RECOMMENDED PROJECTS AND CONCEPTUAL OPINION OF PROBABLE COST (2033)

Given each analysis above we provide the following list of improvements and conceptual cost. For the listed items unrelated to the recommended fire flow upgrades, these were developed in conjunction with EPCOR for known required projects.

One notable project is the AC watermain replacement program, this scope is mentioned below however a specific list and quantity is required from EPCOR.

French Creek Water System 2033 Opinion of Probable Cost
Items Not Included in Cost Estimate
1. Engineering design and further assessments 2. Geotechnical investigations 3. Environmental Impact studies and mitigation 4. Archeological encounters and mitigation 5. Owners Administration 6. Topographic Surveys
General Notes
1. Pipe lengths are estimated between pump and connection point 2. Opinion of probable costs are based on preliminary information only and conceptual evaluations and are subject to wide variation in quantity and cost 3. Costs are in 2020 Dollars

Limits of Commission:					
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.					
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**	**Breakout[1]**
Projects Established with EPCOR					
R8 Well Treatment	Lump Sum	1	250,000	250,000	RB = 100%
Close Auxiliary French Creek Well (Has not been used since 1997 is a liability risk. Removal of pump and old shack and filling in dug well)	Lump Sum	1	25,000	25,000	RB = 100%
Leak detection study	Lump Sum	1	30,000	30,000	RB = 100%
Church Road watermain exposed near Morningstar Creek (pipe bursting)	Lump Sum	1	100,000	100,000	RB = 50%[2] D = 50%
System AC watermain replacement program	Meter	TBD			RB = 100%
Projects Established as a Result of our Analysis to Improve Serviceability					
Upgrade 200mm Watermain to 250mm: Old Island Highway	Meter	300	500	150,000	RB = 50%[2] D = 50%
Install 400mm Watermain: Church Road Twinning	Meter	3580	700	2,506,000	RB = 50%[2] D = 50%
Upgrade 200mm Watermain to 250mm: Riley Road	Meter	410	500	205,000	RB = 50%[2] D = 50%
			Sub -Total	**3,266,000**	
			40% Contingency	**1,306,400**	
			Total	**4,572,400**	

1 Within the breakout column D = development funded and RB = rate based funded as a percentage.

2 The rate based user and developer would equally benefit from each of these improvements as this improves a deficient system and also allows for increased density / development.

3 Pressure reducing valve stations, along with isolation valves, will be required to create another pressure zone in the system once the new Church Road pressure boosting pumps are operational. The new increased HGL of the system will create unwarranted pressures at lower elevations in the system. Since the increase in pressure is required for new development in the Wembley – Manse area, the percentage of developer funding for this cost should be the same as the Church Road booster pumps.

7.0 TWENTY YEAR ASSESSMENT (2043)

The 20-year assessment includes suggested improvements for the remaining deficient serviceability issues and ultimate fire flow for the industrial areas serviced by the Church Road upper pressure zone. Further

development of supply wells and capacity are not specifically quantified in each assessment but is a known issue throughout with EPCOR's direct involvement required when exploring new capacity sources.

7.1 FIRE FLOW (2043)

The industrial zones located along Springhill Road and surrounding the Church Road Reservoir will be serviced by the pumped Church Road Reservoir site. The required fire flow stated by MMCD is 225 L/s which exceeds the ability of the existing Church Road diesel driven fire pump. Necessary upgrades would include a new pumping system and transmission main to the requested industrial developed site with a minimum 300mm diameter pipe.

7.2 DOMESTIC WATER PRESSURE (2043)

When evaluating the minimum pressure for the 20-year design flows for both MDD and PHD scenarios, we find the system is able to provide the specified flow within minimum pressure requirements. The evaluation includes using the suggested Church Road Booster Station quoted in Chapter 5, and an additional pump added to the lineup as stated in Chapter 6.

Over pressure management is suggested within the long term plan, the following figure suggests the green area contain pressure reducing valves to establish a pressure range from 43 psi to 75 psi without the use of single pressure reduction. We recommend two PRV's are installed looping the upper water system to the lower system and closing strategic line valves to establish the pressure boundary.

Benefits of introducing system pressure management include reduced leakage, mitigating stress on pipes and bends, and reducing maintenance costs on older weaker sections of distribution piping.

WATERMAIN DIAMETER (mm)

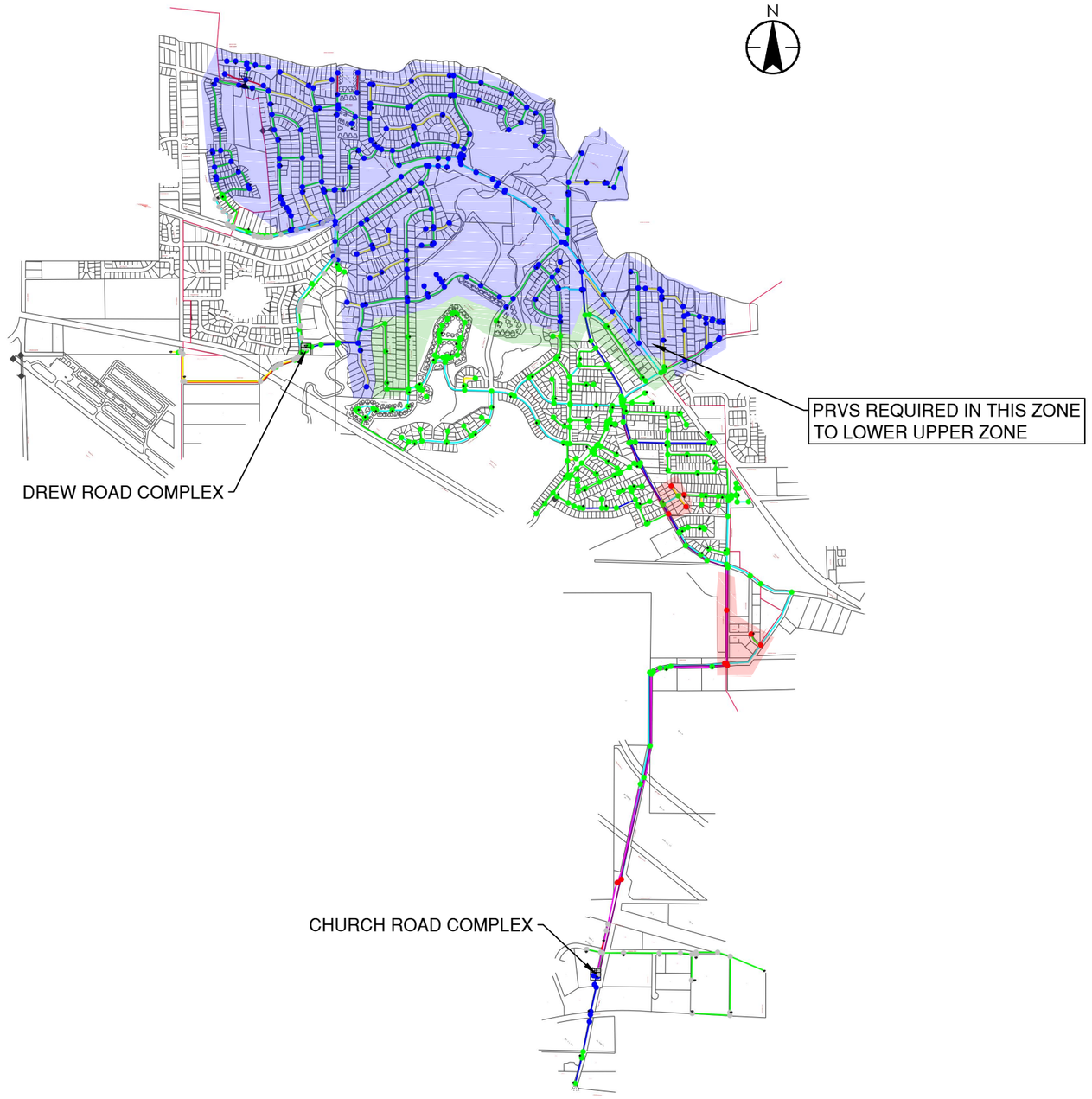
- 50Ø
- 75Ø
- 100Ø
- 150Ø
- 200Ø
- 250Ø
- 300Ø

PEAK HOUR PRESSURE (PSI)

- <43
- 43.1 - 75.0
- 75.1 - 123
- > 123

ZONES

- HIGH PRESSURE AREA (OVER 75 PSI)
- LOW PRESSURE AREA (UNDER 43 PSI)
- PRV REQUIRED ZONE



FLOW DEMANDED: 76.4 L/S

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Figure No.

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Title

PEAK HOUR DEMAND
(2040)

7.3 STORAGE CAPACITY (2043)

Table 7-1 Storage Assessment (2043)

Storage Capacity (2043 - Projected) **(For Projected Data Refer to section 2.2 Growth Rate Calculation)**			
	Flow (L/s)	**Duration (hrs)**	**Storage Required (m^3)**
A. Required Fire Flow (Industrial Development)	225	2.0	= 1620
B. Maximum Daily Demand (Equalization Storage 25% MDD)	55.3	24	= 1203
C. Emergency Storage (Storage 25% of A +B)	-	-	= 706
Total Required Storage **(A + B + C)**	-	-	= 3529
Available Storage Capacity (2023)			
Church Road Reservoirs	2654 m^3		
Drew Road Reservoirs	1300 m^3		
Total Available Storage	3954 m^3		
Deficiency **(Total Available – Total Required)**	$3954\ m^3 - 3529\ m^3 =$ $\boldsymbol{425\ m^3}$ **Deficient Storage**		

Based on the above analysis using 2043 MDD design flows, we recommend the existing Church Road reservoir is upgraded to its ultimate capacity of 1,400 cubic meters of storage.

7.4 WELL CAPACITY (2043)

The following table represents the known supply from the wells and the extrapolated 2040 MDD value.

Table 7-2 Groundwater Wells Capacity

Year	**MDD**	**Supply Capacity of Groundwater Wells – MDD = Flow Difference**
2043	**[55.3 L/s]** Projected Consumption (For Projected Data Refer to section 2.2 Growth Rate Calculation)	55.6 – 55.3 = **0.3 L/s**
The following assumptions were made when calculating the well capacity: • Existing Supply Capacity of Ground Water Wells [56.5 L/s] calculated in section 4.7 Well Capacity • MDD demand is derived with the assumption that the demand would increase at the same rate as the population.		

The above carries the known capacity issue through to the 2043 outlook. Additional source and capacity exploration are required to accommodate the prescribed 1.2% growth rate.

7.5 RECOMMENDED PROJECTS AND CONCEPTUAL OPINION OF PROBABLE COST (2043)

We recommend the following long term improvements given our analysis above to meet industrial fire flows, storage, and correct known pressure management deficiencies.

French Creek Water System Long Term 2043 Opinion of Probable Costs
Items Not Included in Cost Estimate
1. Engineering design and further assessments 2. Geotechnical investigations 3. Environmental Impact studies and mitigation 4. Archeological encounters and mitigation 5. Owners Administration Topographic Surveys
General Notes
1. Pipe lengths are estimated between pump and connection point 2. Opinion of probable costs are based on preliminary information only and conceptual evaluations and are subject to wide variation in quantity and cost Costs are in 2020 Dollars
Limits of Commission:
Whereas any opinions of probable cost prepared by Stantec Consulting Ltd. ("the Engineer") will be based on incomplete or preliminary information, and will also be based on factors over which the Engineer has no control, the Engineer does not guarantee the accuracy of these opinions of probable cost and shall have no liability where the probable costs are exceeded.

French Creek Water System Long Term 2043 Opinion of Probable Cost					
Description	**Units**	**Quantity**	**Rate ($)**	**Amount ($)**	**Breakout[1]**
Projects Established with EPCOR					
Groundwater Exploration (Exploratory Boreholes). Electrical Resistivity tomography (EMT) to map a portion of the aquifer and drilling boreholes.	Lump Sum	1	149,000	149,000	RB = 50%[2] D = 50%
Re-drill wells[3]	Each	9	250,000	2,250,000	RB = 50%[2] D = 50%
Projects Established as a Result of our Analysis to Improve Serviceability					
Church Road Complex: Reservoir Expansion (adding panels to existing reservoir)	Lump Sum	1	337,500	337,500	D = 100%
Church Road Complex Fire Pump	Lump Sum	1	450,000	450,000	D = 100%
			Sub -Total	**3,186,500**	
			40% Contingency	**1,274,600**	
			Total	**4,461,100**	

1 Within the breakout column D = development funded and RB = rate based funded as a percentage.

2 The rate based user and developer would equally benefit from exploration of new supply sources given the expiration of existing wells and the introduction of additional supply for development.

3 Re-drilling of wells does not include every existing supply well within the system as EPCOR will and continue to focus on well rehabilitation including general maintenance to sustain extraction rates.

8.0 REFERENCES

1. **EPCOR French Creek Water Inc.** *Model Basis Calculations.xls.* 2019.
2. **RDN.** *A Bylaw to Establish the Electoral Area 'G' Official Community Plan. BYLAW No. 1540.*
3. **MMCD.** *Design Guidlines.* 2014.
4. **EPCOR.** *17508SITE.dwg.* French Creek : EPCOR, April 2018. Existing Water System Plan. 175-008.
5. **Stantec.** *French Creek Updated Pinetree Centre Domestic and Central Builders Domestic Water Connection Assessment.* March 14, 2019.
6. —. *Church Road Pump Station New Reservoir - Phase 3.* April 8, 2011.
7. **Ker Wood Leidal Association Ltd.** *French Creek 2014 Master Plan Update.* Burnaby : KWL, December 8, 2014.
8. **Stantec.** *EPCOR French Creek Growth Assessment Study.* October 2011.
9. **Stantec.** *EPCOR French Creek Water System Demands and Design Standards Review.* June 2023
10. **Waterline Resources Inc.** *EPCOR French Creek Water Supply Investigaion.* August 2023