APPENDIX A:

Water Demand Design Standard Review, 2017 Update – Koers & Associates Engineering

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July 6th, 2017
1644-01

District of Lantzville
7192 Lantzville Rd
PO Box 100
Lantzville, BC V0R 2H0

Attention: **Mr. Fred Spears**
Director of Public Works

Re: **District of Lantzville**
Water Master Plan
Water Demand Design Standard Review, 2017 Update

We are pleased to submit our Water Demand Design Standard Review Study, 2017 Update as part of the overall Water Master Plan assignment and Official Community Plan (OCP) update that is currently underway. The update report compares current water system demand patterns, both within the District and in nearby water systems, and analyses design standards that are currently being applied in the Mid-Vancouver Island area.

This updated report reinforces the recommendations made previously in the May 2016 Water Demand Design Standard Review. Specifically, that although a reduction in per connection demand may be warranted when assessing actual consumption patterns within the District and when comparing standards in neighbouring jurisdictions, the District would be well-served to improve system redundancy and capacity as a first step.

This updated report also reviews possible design standards for land use categories other than residential dwellings, specifically the multi-family and higher density land uses that are being considered as part the current OCP review process. Based on higher densities and the potential need for less irrigation, lower per capita design demands for this land area are presented for consideration.

We have enjoyed working on this important study. We would be pleased to discuss implementation of the recommendations with staff and Council and look forward to assisting the District in the further development of its water system.

Yours truly,

KOERS & ASSOCIATES ENGINEERING LTD.

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.J. HOFFMAN

Chris Holmes, PEng
Project Engineer

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Project Manager

District of Lantzville

WATER MASTER PLAN
WATER DEMAND DESIGN STANDARD REVIEW, 2017 UPDATE

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1 INTRODUCTION

1.1 Background

The District of Lantzville's (DoL) current per connection design water demand of 3,400 L/day has been the standard in Lantzville for a long time, reaching back to pre-incorporation days when the DoL water system was operated by the Lantzville Improvement District. It is believed that the design demand was mainly based on the 0.5 Igpm per connection flow rate that the Regional District of Nanaimo (RDN) had been using as a design standard for developer-built water systems in the rural areas of the RDN that relied upon groundwater wells as the source of water.

We understand that the concept was that at a minimum, any new development had to supply a quantity of water that equalled or exceeded the amount of water that would be needed to supply the new development. Given the variability and potential for declining well yields over time, we understand that a high factor of safety was built into the design rate.

With a larger centralized system containing updated storage and supply capability, having new developments add wells on a case-by-case basis is not necessarily practical or desired, as supply and treatment regimes become more complex. Having water sources spread throughout the DoL is not considered to be an economical approach in terms of managing infrastructure.

The 3,400 L/day per connection has also been used to determine the number of connections that the DoL can supply, based upon the current rating of the DoL's well field. Before the Water Supply Update was published in July 2015, the capacity of the well field was assessed at 800 to 1,000 m^3/day which, when using the 3,400 L/day per connection target, indicated a net deficiency of water within the system. However in May 2016, with several years of metering and consumption data available for review, and an updated assessment of the well field's aquifer capacity, the DoL requested an updated evaluation of the current design standard. Koers and Associates Engineering Ltd. (KAEL) produced a report titled "Water Demand Design Standard Review" which reviewed historical usage patterns, compared water usage and standards in other jurisdictions, and provided recommendations on potential design standard revisions.

In conjunction with the Water Master Plan assignment that the DoL is currently undertaking, KAEL was requested to provide an update on proposed water system demand design standards as they could relate to potential new land uses within the DoL which are being contemplated under the concurrent Official Community Plan (OCP) review process. Additional water meter review data from 2014 to 2017 was also provided for use in this study.

1.2 Study Purpose

To review existing design water demands for the DoL, compare against existing consumption data, compare against other local jurisdictions, and recommend design demand standards for the following land-uses:

- Single Family, and
- All other types of dwellings and connections, e.g.,
  - Multi-Family
  - Commercial

- Industrial
- Institutional

A review of target fire flow demands was not requested by the DoL in this study, but has been recommended to the DoL in previous studies.

1.3 Scope of Work

To accomplish the study purpose, the following work plan was adopted:

Task 1 – Obtain & Analyze Water Demands

- Obtain from DoL, bulk metering (upper zone, lower zone and wellfield) and all individual water meter demand spreadsheets.
- Process and incorporate data into analyses carried out under previous studies:
  - District of Lantzville, Water Supply & Distribution System Study, July 2015
  - District of Lantzville, Water Demand Design Standard Review, May, 13, 2016
- Determine revenue and non-revenue water demands.
- Determine average day, maximum day and per capita demands.
- Determine residential water demands.
- Compare residential water demands by location/lot size, i.e., waterfront lots vs Upper Lantzville lots.
- Compare residential demands against other Vancouver Island municipalities.

Task 2 – Non-Residential Design Water Demands

- Review the DoL's actual demands for non-residential properties (e.g., commercial, industrial, public facilities)
- Compare DoL demands against other Vancouver Island municipalities.

Task 3 – Report Findings

- Present findings in a report complete with tables and figures.
- Include an overview of the work completed, the findings and the recommendations for:
  - per capita average day, maximum day and peak hour demands.
  - per connection design demand for Single Family Residential and Multi-Family Residential.

1.4 Acknowledgements

Koers & Associates Engineering Ltd. acknowledges, with thanks, the assistance provided by District of Lantzville staff and Lanarc Consultants during the preparation of this report.

2 WATER DEMANDS

2.1 Annual Usage

2.1.1 Bulk Water Meter

Water demands in the DoL are recorded by three bulk water meters, all located at the Ware Road reservoir, as follows:

- The first bulk meter records the volume extracted from the wellfield as it enters the Ware Road reservoir.
- The second bulk meter records the volume leaving (by gravity from) the Ware Road reservoir as into the lower pressure zone.
- The third bulk meter records the volume leaving (by pumping from) the Ware Road reservoir and into the upper pressure zone.

The DoL's SCADA system automatically records the volume measured each day by each meter.

A comparison of the total annual metered volume between the wellfield flow meter and the sum of the lower and upper pressure zone meters was carried out for the past six years (2011 – 2016). The comparison revealed the wellfield metered volume to be 7.3% to 7.5% lower than the combined total of the upper & lower pressure zones metered volumes as shown in **Table 1**.

Table 1 – Wellfield vs Upper & Lower Pressure Zone Bulk Meter Annual Volumes, 2011 - 2016

Year	Wellfield Metered Volume (m^3/year)	Upper + Lower Zone Metered Volume * (m^3/year)	Difference	
			(m^3)	(%)
2011 **	186,857	200,533	13,676	7.3 %
2012	226,554	243,025	16,471	7.3 %
2013	225,998	242,420	16,422	7.3 %
2014	233,786	250,929	17,143	7.3 %
2015	225,327	242,205	16,878	7.5 %
2016	224,648	241,522	16,874	7.5 %

Note

* For the purposes of this study, the higher value (Upper + Lower Zone) has been used as the DoL's total annual system annual demand when calculating the annual average day and maximum day demands.

** Missing 3 ½ months of data (Jan 1 to March 15, 2011).

2.1.2 Individual Water Meters

The DoL is a fully metered water system with a total of 885 individual water meters. The meters are read every three months and customers are billed based on consumption.

The total volume recorded by the 885 meters was compared against the volume recorded by the combined total of the upper & lower pressure zones meters for each quarter and annually over the past six years (2011 - 2016). As anticipated, the sum of the individual meters was lower than the combined upper & lower pressure zones meters as not all water usage is metered (this is discussed further under **2.1.3 Revenue & Non-Revenue Water Demand**.) The amount of the difference varied from quarter to quarter and from year to year. The largest and smallest quarterly differences were in the second quarter (April – June) and third quarter (July – Sept) respectively, and with Year 2015 having the largest quarterly and total annual difference. In the third quarter of 2016 (July – Sept,) the total of the individual meters exceeded the combined total of the upper & lower pressure zones meters. The reason for this exceedance could not be determined.

A comparison of the annual total demands is presented in **Table 2.** A comparison of the quarterly and annual demands is graphically shown in **Figure 1**.

Table 2 – System Demand vs Individual Metered Demand, 2011 – 2016

Year	Individual Meters (m^3/year)	Upper + Lower Zone Metered Volume * (m^3/year)	Difference (Non-Revenue Water)	
			(m^3)	(%)
2011 **	158,933	191,268	32,780	18 %
2012	203,413	243,025	39,612	16 %
2013	195,043	242,420	47,372	21 %
2014	196,085	250,929	54,844	22 %
2015	169,380	242,205	72,826	30 %
2016	218,237	241,522	23,285	11 %
5 Yr Ave (2012 – 2016)	196,432	244,020	47,600	20 %

Note

* For the purposes of this study, the higher value (upper + lower zones) has been used as the DoL's total annual system demand when calculating the annual average day and maximum day demands.

** Missing first three months of 2011 (Jan, Feb, March).

The percentage of non-revenue water, while a noticeable amount, is not unexpected or unusual for a water system of this size, age and operating pressures.

2.1.3 Revenue & Non-Revenue Water Demand

The total demand placed on the DoL's water system can be divided into two components and can be expressed in the following equation:

Total Annual Demand = **Revenue Water** + **Non-Revenue Water**

where:

Total Annual Demand	=	Total of upper pressure zone + lower pressure zone meters
Revenue Water	=	Water usage for which a cost is charged
Non-Revenue Water	=	Water usage which not charged

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Total Individual vs Upper & Lower Zone Bulk Metered Quarterly Demand (2011 - March 2017)

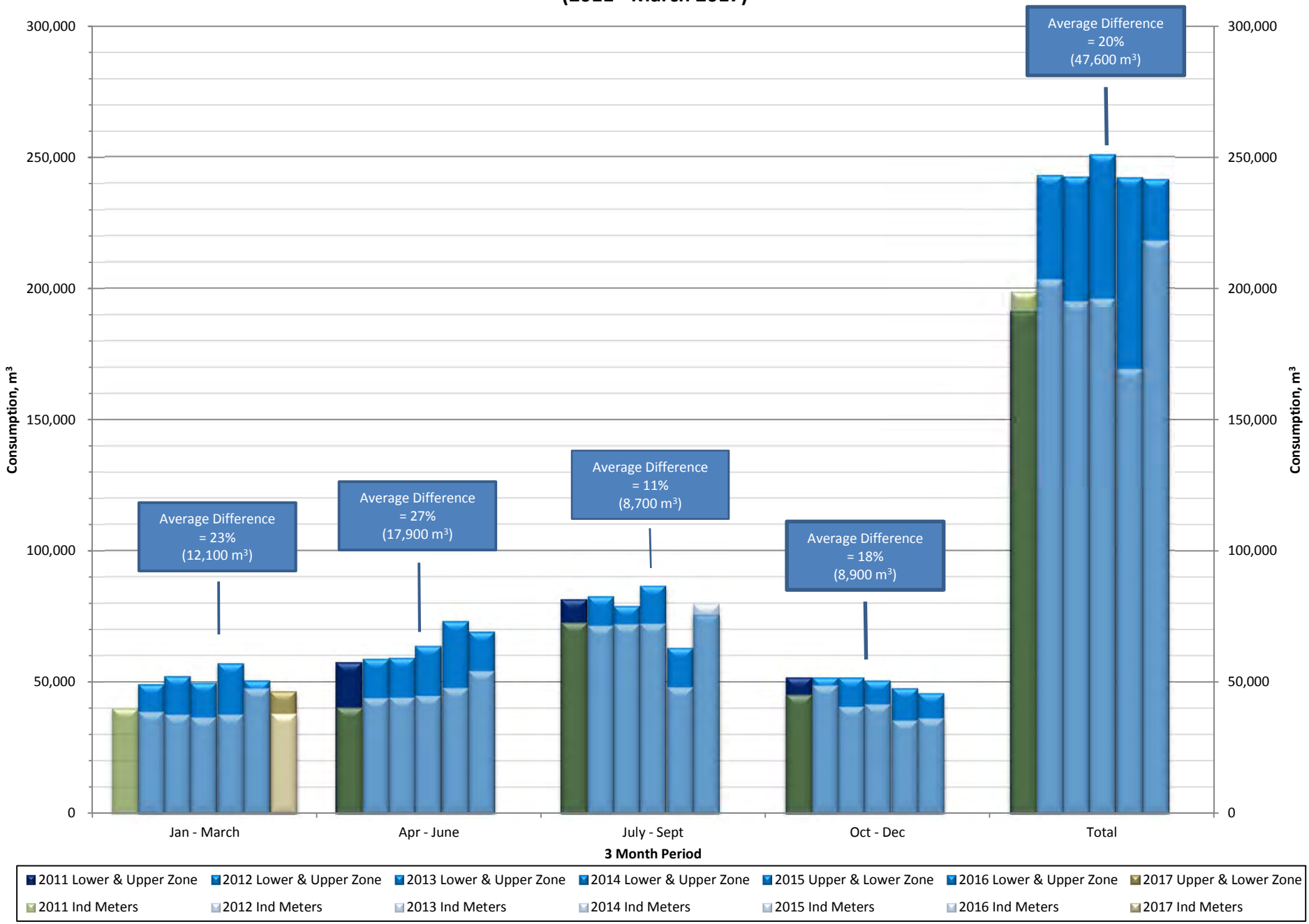


FIGURE 1

Revenue Water in the DoL is the sum of the metered volume of the individual water meters, of which there are presently 885 meters.

Non-Revenue Water is made up of three components and can be expressed in the following equation:

Non-Revenue Water = *Unbilled Authorized Consumption + Apparent Losses + Real Losses*

The volume associated with each component can be made up of the following:

Unbilled Authorized Consumption

- Watermain flushing
- Sewer main flushing
- Fire department training and actual fire fighting
- Public space irrigation (playfields, parks, boulevards, gardens)
- Public facilities (outdoor washroom)

Apparent Losses

- Metering inaccuracies
- Water theft

Real Losses

- Leakage on transmission and/or distribution mains
- Leakage on service connections up to the customer's meter
- Leakage on fire hydrants, air release valves, flushouts

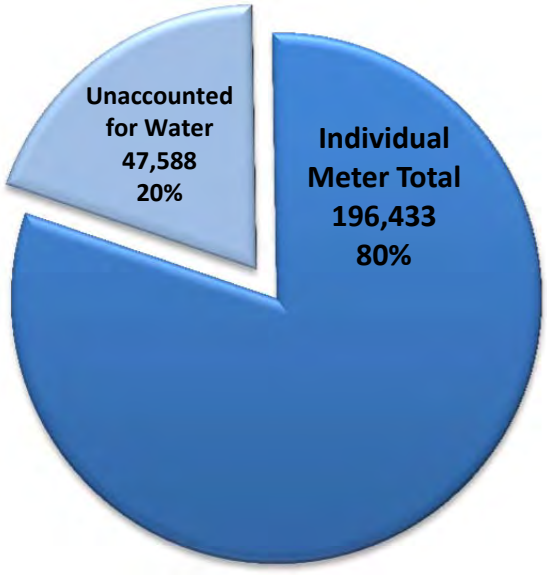
Non-Revenue Water can be determined by the following equation:

Non-Revenue Water = Bulk Water Meter – Sum of Individual Water Meters

The calculated annual volume of non-revenue water for the past six years is shown in **Table 1**. The quarterly and annual volumes are presented in **Figure 1**.

Even though non-revenue water is not metered or billed, this volume needs to be considered as part of the overall assessment, as the system will generally require this volume on a regular basis, and it needs to be factored in to the annual system demand. A comparison of the average of revenue and non-revenue water demand (individual meters total and the upper & lower pressure zone meters total) for the past five years (2012 – 2016) is presented in **Figure 2**.

Figure 2 – Revenue & Non- Revenue Water, 5 Year Average, 2012 - 2016



2.2 Daily Usage

2.2.1 Average Day & Maximum Day

A review of the DoL's total annual, average day, maximum day and maximum week demands for the past 21 years (1996 to 2016) revealed that between 1998 and 2011, the total annual and average day demand decreased by more than 25% while maximum day demand decreased by slightly less than 20%. Since 2011, average day, maximum day and maximum week demands have remained stable. A summary of the data is shown in **Table 3.** The daily demand data from 2011 to present (May 2017) is presented in **Figure 3**.

Table 3 – Annual, Ave Day, Max Day & Max Week System Demand, 1996 – 2016

Year	Annual Demand * (m^3)	Average Day (m^3/day)	Maximum Day (m^3/day)		Max/Ave Ratio	Maximum Week (m^3/day)	
1996	312,568	854	1,783	July 12	2.09	-	
1997	292,421	801	1,563	Aug 12	1.95	-	
1998	329,371	902	1,551	July 28	1.72	-	
1999	286,666	774	1,530	June 11	1.98	-	
2000	-	-	1,578	Aug 15	n/a	-	
2001 - 2002	-	-	-	-	-	-	
2003	287,983	789	-	-	-	-	
2004	277,804	759	-	-	-	-	
2005	269,840	739	-	-	-	-	
2006	278,737	764	-	-	-	-	
2007	275,844	756	-	-	-	-	
2008	279,628	764	-	-	-	-	
2009	283,078	776	-	-	-	-	
2010	256,568	703	-	-	-	-	
2011	243,380	667	1,263	Sept 11	1.89	1,060	July 1 – 7
2012	243,025	664	1,351	July 14	2.03	1,105	July 8 – 14
2013	242,420	664	1,232	July 28	1.85	1,114	July 24 – 30
2014	250,929	687	1,421	July 14	2.07	1,227	July 12 – 18
2015	242,205	664	1,273	June 15	1.92	1,136	June 9 – 15
2016	241,522	660	1,192	July 28	1.81	1,088	Aug 14 - 20
5 Yr Ave (2012 – 2016)	244,000	670	1,295		1.93	1,135	

Notes:

* Sum of upper pressure zone + lower pressure zone bulk water meter readings.

\- Data not provided in a format that was practical to determine the per day use.

Figure 3 presents the total annual, average day, maximum day, and maximum week demands from 1996 to 2016. The BCStats population estimate on **Figure 3** is for the entire DoL. The population that is serviced by the municipal water system is less than this as not all properties in the DoL are connected to the municipal water system. Properties that are not connected are serviced by their own private wells.

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District of Lantzville
Demands (Annual, Ave Day, Max Day) & Population 1996 - 2016

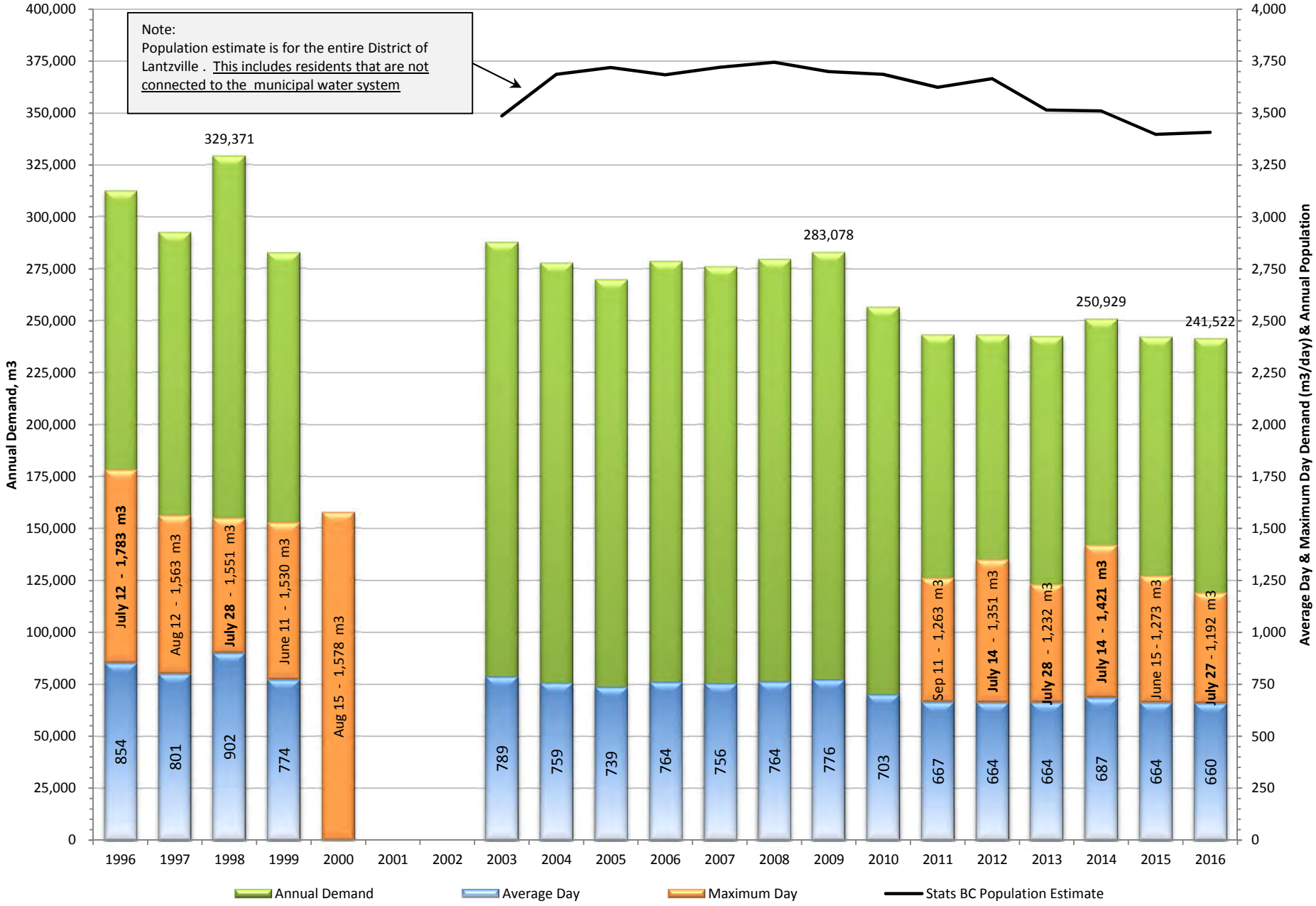

FIGURE 3

2.2.2 Per Capita Demand

2.2.2.1 District of Lantzville

The most recent five years (2012 – 2016) of demand data in **Table 3** was converted into a per capita demand. The results are presented in **Table 4**.

Table 4 – Estimated Lantzville Per Capita Ave Day, Max Day & Max Week Demand, 2012 - 2016

Year	Service Population Estimate *	Average Day ** (lpcd)	Maximum Day ** (lpcd)	Maximum Week ** (lpcd)
2012	2,143	310	631	516
2013	2,143	310	575	520
2014	2,143	321	663	573
2015	2,143	310	594	530
2016	2,143	308	556	508
5 Yr Ave	2,143	310	605	530

Notes:

* Based on 2011 Census population density of 2.46 capita per dwelling and an estimated 871 residential dwelling units (serviced from 840 individual water meters).

** Based on Upper Pressure Zone + Lower Pressure Zone bulk water meter readings.

2.2.2.2 Other Vancouver Island Municipalities

Lantzville's per capita demands were compared against other mid and west Vancouver Island communities utilizing data from water studies completed by KAEL. The findings are presented below in **Table 5**.

Table 5 – Per Capita Ave and Max Day Demand, Vancouver Island Communities

Community	Study Year	2011 Canada Census Population	Per Capita Demand			
			Average Day (lpcd)		Maximum Day (lpcd)	Max/ Total Ave
			Residential +	Total ++		
Lantzville *	2017	3,643	230 #	310 ##	605 ###	1.95
Saltair *	2016	2,069	245	340	580	1.7
Ladysmith *	2013	8,800	---	400	720	1.8
Cumberland *	2015	3,398	200	425	600	1.4
Comox	2012	13,627	---	490	895 **	1.8 **
Courtenay	2015	24,099	---	525	1,240 **	2.4 **
Nanaimo *	1998	83,810	---	540	1,050	1.95
Parksville *	1995	11,977	---	540	1,180	2.2
Qualicum Beach	2003	8,687	---	570	1,420	2.5
Port Alberni *	2015	17,743	235	590	900 **	1.5 **
Campbell River	2017	31,186	---	700	1,685	2.4
Gold River	2002	1,267	785 ***	865	2,250	2.6
Tofino *	2000	1,876	330	1,008	2,170	2.2
Ucluelet	2012	1,627	995 ***	1,270	2,130 **	1.7 **
Sayward	2017	317	---	1,410	7,720	5.5

Ave (excluding: Tofino, Ucluelet and Sayward) **&**	---	---	540	1,175	2.2

Notes:

Numbers in **bold red lettering** indicate lowest value for that column.

+ Residential average day per capita demands are calculated as the annual sum of all residential metered demands divided by the estimated service population, except where noted otherwise.

++ Total Average Day per capita demands are calculated as the total demand of the entire water system divided by the estimated service population.

***** Indicates municipalities which meter both residential and commercial properties.

****** Calculated by taking the maximum month demand and dividing by the number of days in the month as the daily demand data was not available. Actual maximum day demand and the resulting peaking ratio would be higher.

******* These are non-metered demand values calculated as the difference between system demand and the commercial/industrial metered demands. As such, they are not solely residential demand but include all system water use excluding commercial/industrial use.

Based on individual metering data for 2016. Value is sum of individual residential meters (182,429 m^3) divided by an estimated service population of 2,143.

Based on total system metering demand (upper pressure zone + lower pressure zone bulk water meter readings) for 2016. Value is total system demand (241,522 m^3) divided by estimated service population of 2,143.

Based on total system maximum day demand (upper pressure zone + lower pressure zone bulk water meter readings) of 1,192 m^3 (July 28, 2016) divided by an estimated service population of 2,143.

& Tofino is not included because of the influence of the water demands from the large tourism population. Ucluelet is not included because of the influence of water demands by the fish processing plants. Sayward is not included due to the large influence of the water demands from the logging dry land sort.

It is noted that the DoL's per capita demands are the lowest of the 15 municipalities reviewed. It is also noted that they are more than 40% lower than the City of Nanaimo, with whom they share a municipal boundary, and the City of Parksville, its closest neighbour to the west/north. It is believed the awareness of the Lantzville residents and businesses of:

- the historical perception of limited capacity of the wellfield,
- the requirement that new development secure their own water supply sources, and
- the inclining block pricing (Bylaw No. 85)

are factors contributing to the low per capita demand. It is also noted that residential water usage tends to be higher in other Island municipalities where water demand is not metered.

2.3 Demands by Land Use

2.3.1 District of Lantzville

The annual demand, demand per connection, and percent demand per land-use category for the past five years along with the 5 year average are presented in **Table 6**.

Table 6 – Annual Demand by Land-Use, 2010 - 2016

Description	Land-Use Category						Total Individual Meters	Total System Demand # (m^3)
	Comm-ercial	Com/ Res	Public Use	Industrial	Other Res.	Residential		
Number of Meters	14	5	8	18	17	823	885	
Annual Total of Individual Meter Demands (m^3)								
2010	7,818	* 13,007	3,375	3,103	6,834	181,840	215,977	256,568
2011	6,195	2,893	3,835	2,781	7,469	175,460	198,633	243,380
2012	7,318	3,144	4,454	2,539	6,892	179,066	203,413	243,025
2013	7,220	3,639	4,482	2,715	6,468	170,524	195,048	242,420
2014	7,101	3,640	5,190	2,312	5,785	172,057	196,085	250,929
2015	5,564	4,019	1,936	3,229	4,730	149,826	169,304	242,205
2016	7,024	4,388	** 15,811	3,287	5,298	182,429	218,237	241,522
5 Yr Ave (2012 – 2016)	6,845	3,766	** 4,375	2,816	5,835	170,780	196,417	244,000
% of Total System Demand	3 %	2 %	2 %	1 %	2 %	70 %	80 %	100%
Average Demand Per Lot (m^3/Lot)								
5 Yr Ave (2012 – 2016)	489	753	** 547	156	343	208	222	276

Notes:

Total system demand is the sum of the upper pressure zone + lower pressure zone bulk meters.

***** A review of the 2010 data revealed an excessively high demand (10,340 m^3) occurred in the second quarter at a single connection (6690 Dickinson Road) compared to the 202 to 534 m^3 for the same period in other years. The cause of the high demand could not be determined.

****** A water leak was reported in March 2016 for the Royal Canadian Legion (7225 Lantzville Road). The Legion's demand for this quarter in 2016 was 10,174 m^3 compared to the 108 m^3 in 2015 and 135 m^3 in 2014. The five year average demand per connection is based on the exclusion of 10,000 m^3 from the first quarter of 2016 for the Legion.

The data in **Table 6** reveals that residential demands dominate system demand. Although the non-residential use is higher on a per connection basis, these properties have less influence on the overall system demands since they are much fewer in number. The total system demand is higher

than the sum of the individual meters because it includes the non-revenue water usage in shown in **Table 2**, **Figure 2**, and discussed under **2.1.3 Revenue & Non-Revenue Water Demand**

2.3.1.1 LANTZVILLE RESIDENTIAL DEMAND BY LOCATION & LOT SIZE

A comparison of residential demand by location and lot size was carried out to assess if demands vary by these parameters. Four groups were reviewed:

- Waterfront lots (approx. +/- 0.45 ha)
- Waterfront lots (approx. +/- 0.12 ha)
- Upper Pressure Zone lots (approx. +/- 0.12 ha)
- Lower Pressure Zone lots (approx. +/- 0.1 ha)
- All residential lots (varying sizes)

The quarterly and annual demands from 2010 to 2014 (five years) were analysed for average, median, maximum, and minimum demands for each of the four groups. The analyses indicated a general correlation between increasing demand with increasing lot size. The location of a similar sized lot (waterfront vs non-waterfront) did not reveal a significant difference on water demand. For all five groups, the lowest quarterly demand occurred in the 1st quarter (Jan – Mar) and the highest quarterly demand occurred in the 3rd quarter (June – Sept). The average annual demand for each group is presented in **Table 7**.

Table 7 – Lantzville Residential Water Demands vs Lot Size, 2010 - 2014

Group Location	Lot Size (ha)	Number of Lots (#)	Annual Demand * (m^3/year per Lot)	With Inclusion of Non-Revenue Water	
				Annual Demand ** (m^3/year Per Lot)	Average Day Per Capita *** (lpcd)
Waterfront	0.45	48	251	310	340
Waterfront	0.12	20	202	245	275
Upper Lantzville	0.12	201	209	255	285
Lower Lantzville	0.10	160	196	240	270
All of Lantzville	varies	823	214	260	290

Notes:

* Total of the individual meters divided by the number of meters for the 5 year average of 2010 – 2014.

** Includes allowance for the volume of non-revenue water within the water system. For the 5 year average of 2010 – 2014, this equates to 22.5% of the total of all the individual water meters (247,300 m^3 ÷ 201,800 m^3 = 1.225).

*** Based on the five year average of 365.2 days/year and a population density of 2.46 capita per dwelling unit.

A graph of the average and median quarterly and annual demand for each category based on the five years of 2010 to 2014 is shown in **Figure 4**. The location of each lot for each group (excluding the "all of Lantzville" group) is shown in **Figure 5**, **Figure 6**, **Figure 7** and **Figure 8**.

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District of Lantzville
Water Demand Per Lot, Varying Residential Lot Size
5 Year Ave (2010 - 2014)

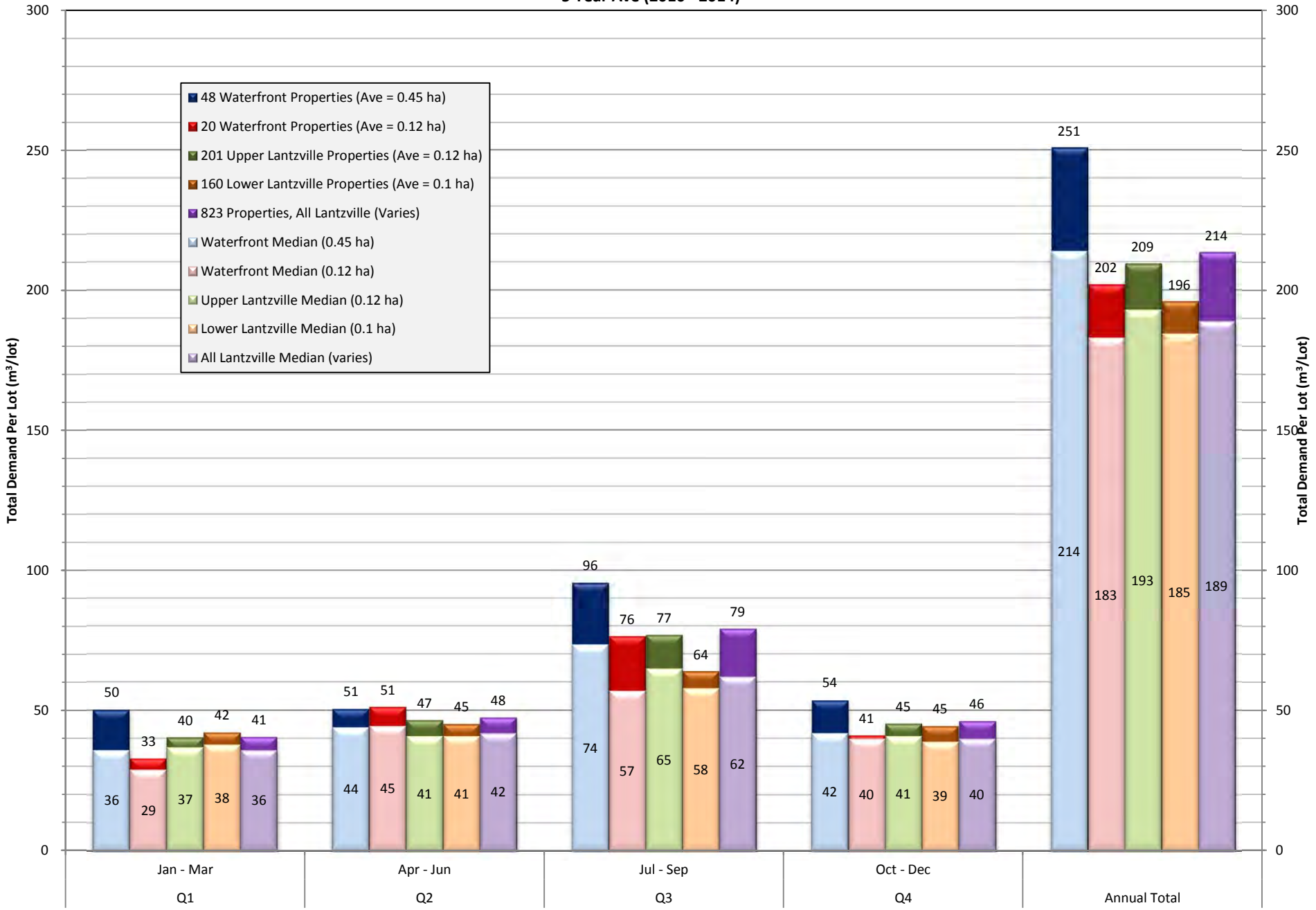

FIGURE 4

Figure 5 – Waterfront Residential Lot Locations (0.45 ha)

Ave Size = 0.45 ha
Zoning: RS-1L

Figure 6 – Waterfront Residential Lot Locations (0.12 ha)

Ave Size = 0.12 ha.
Zoning: RS-1L

Figure 7 – Upper Lantzville Residential Lot Locations (0.12 ha)

Average Size = 0.12 ha
Zoning: RS-1L

Figure 8 – Lower Lantzville Residential Lot Locations (0.1 ha)

Average Size = 0.1 ha
Zoning: RS-1L

2.3.2 Other Vancouver Island Municipalities

The actual demands from several mid-Vancouver Island municipal water systems were reviewed and compared against the DoL for three common land-use categories. Data for the same year (2012) was used for each municipality so as to eliminate demand variations due to weather. The findings are presented in **Table 8.**

Table 8 – Annual Water Demands by Land Use, Vancouver Island Communities

Municipality, Service Area, Improvement District	Data Year	Annual Metered Water Demand			Entire System [1]
		Single Family (m^3/dwelling)	Multi-Family (m^3/dwelling)	Commercial (m^3/unit)	
Tofino	2012	182	110	590	- [2]
Parksville	2012	199	n/a	2,130	-
Lantzville	**2012**	**218 ***	**n/a**	**523 ***	**275**
Port Alberni	2012	236 [3]	236 [3]	5,426 [4]	444
Nanaimo	2012	251	165	-	-
Nanoose Bay Water Service Area	2012	256	204	571	-
Comox	2012	290	150	4,032	-
Comox Valley Water Local Service Area	2012	382	264	771	-
Union Bay Improvement District	2012	-	-	-	361
Cumberland	2015	174	145	-	337
Royston Water Local Service Area	2015	-	-	-	364

Notes:

1 This per connection demand is calculated as the total system annual demand (Upper Pressure Zone + Lower Pressure Zone meters) divided by the number of metered connections. For the DoL in 2012, this is 243,025 m^3 ÷ 885 connections.

2 "-" symbols indicate demand could not be determined due to insufficient information.

3 Consists of all residential property types (e.g., single family and multi-family).

4 Consists of all demands for Industrial/Commercial/Institutional properties.

* Based on total of individual meters for the land-use category divided by the number of meters for the land-use category. The value does not include allowance of the non-revenue water volume.

The findings show that the DoL's single family per dwelling annual demand is lower than its adjoining neighbor, the City of Nanaimo, but higher than the City of Parksville's and the District of Tofino's.

The DoL's annual demand per commercial unit is lower than the others, but does not appear to be unusual. The high commercial demand for other areas is influenced by the nature of the use in those areas, such as resort use or seafood processing.

3 DESIGN DEMANDS

3.1 Current Design Demand Standards

3.1.1 District of Lantzville (DoL)

The DoL Subdivision and Development Bylaw No. 55, 2005 governs the design of water supply and distribution systems. The bylaw requires all new properties within the OCP water service area to connect to the municipal water system. If they are not able, each lot must be provided 3.4 m^3/day (0.5 igpm) of potable water from a well. The bylaw does not provide a design standard for properties connecting to the municipal system.

3.1.2 Other Vancouver Island Municipalities

Water demand design standards for several municipalities on the east coast of mid-Vancouver Island were compared to the DoL standards and are presented in **Table 9**.

Table 9 – Per Capita Design Standards, Mid Vancouver Island Municipalities

Municipality	Per Capita Design Standards			
	Average Day (lpcd)	Maximum Day (lpcd)	Max/Ave Ratio	Peak Hour (lpcd)
MMCD *				
- with meters	300	600	2	900
- without meters	450	900	2	1,350
Nanaimo	455	1,135	2.5	1,820
Parksville	570	1,364	2.4	1,700
Lantzville	**-**	**1,380 ****	**-**	**-**
Qualicum Beach	-	1,780	-	3,150 ***
Courtenay	635	2,100	3.3	3,000
Comox	635	2,100	3.3	3,000
Campbell River	635	2,100	3.3	3,000
RDN (Nanoose / Fairwinds) #			***Capita per Dwelling***	
Residential				
- Single Family (detached)	-	1,168	2.2	-
- Townhouse	-	914	1.9	-
- Apartment/Condo unit	-	424	1.4	-
- Secondary Suite	-	424	1.1	-
- Seniors Living unit	-	424	1.1	-
		(l per 100 m^2) ##		
Commercial				
- Retail	-	520	-	-
- Fitness Centre	-	530	-	-
- Office	-	690	-	-
- Restaurant, Pub	-	3,800	-	-

Notes:

* Master Municipal Construction Document, Design Guideline Manual, 2014. MMCD recommends the use of these metered and non-metered guideline values only if there are no reliable water consumption records and/or specific municipal requirements. It further states that because maximum day and peak hour demands increase significantly in dry climate areas due to irrigation, the criteria should be adjusted accordingly, based on local water consumption records.

** Based on Lantzville Bylaw 55.1 requirement of 3.4 m^3/day potable water source for a lot not connected to the municipal water supply system. Per capita demand is based on the 2011 Census density of 2.46 capita/dwelling units (3,400 L/day per dwelling ÷ 2.46 capita/dwelling).

*** Based on Qualicum Beach Engineering Standard & Specifications Bylaw No. 545 design of 6.05 m^3/day for single family dwelling, duplex. Per capita demand is based on 2011 Census density of 1.92 capita/dwelling unit (6,050 ÷ 1.92).

\# From Regional District of Nanaimo Bylaw No. 500.388, 2013, Schedule 4C1, 2013 Lakes District and Schooner Cove Community Water System Standards. These water demand design standards were developed using the BC Government's 2012 Design Guidelines for Rural Residential Community Water Systems. The BC Government design guidelines calculate max day demand based on the formula:

Max Day = Indoor Usage + Water Loss Allowance + Irrigation Demand – Conservation Incentives.

\## Per 100 m^2 of leasable floor space.

3.2 Proposed Land-Use Based Demand Standards

3.2.1 Residential

In order to assess a revised standard, a comparison to other local municipalities was applied. When considering which other jurisdictions to consider, features such as similarity in climatic conditions and population behaviour were considered. Since Nanoose, Parksville, and Nanaimo are the DoL's closest neighbours, and usage patterns and behaviours could be considered familiar (many people work, visit or shop in their neighbouring communities on a regular basis), a numerical comparison between the various standards was undertaken. In addition, now that the DoL expects to have the ability to obtain water from the City of Nanaimo, as the interconnection main along Lantzville Road is currently being constructed, a comparison against Nanaimo standards was still deemed to be prudent.

Table 10 presents a comparison of:

- DoL's current design standards,
- Proposed residential design standard

Design standards for the three neighbouring communities noted below are shown in Table 9,

- City of Nanaimo (CoN),
- City of Parksville (CoP),
- Regional District of Nanaimo, Nanoose / Fairwinds area, and

Table 10 - Proposed Residential Water Demand Design Standards

Date: July 6th, 2017
File: 1644

Residential Land-Use	Min. Lot Size (m^2)	Dwellings Per Lot (Average) (#)	Existing Lantzville Design Standard: Pop Density (capita per unit)	Existing Lantzville Design Standard: Max Day (l/cap)	Existing Lantzville Design Standard: Max Day (l/con)	PROPOSED Lantzville Design Standard: Pop Density (capita per unit)	PROPOSED Lantzville Design Standard: Ave Day (rounded) (l/cap)	PROPOSED Lantzville Design Standard: Max Day (rounded) (l/cap)	PROPOSED Lantzville Design Standard: Ave Day (rounded) (l/con)	PROPOSED Lantzville Design Standard: Max Day (rounded) (l/con)
Single Family										
1/4 acre	1,000	1	2.4	1,382	3,400	2.4	510	1,150	1,250	2,800
1/3 acre	1,300	1	2.4	1,382	3,400	2.4	515	1,175	1,250	2,850
1/2 acre	2,000	1	2.4	1,382	3,400	2.4	530	1,200	1,300	2,900
1 acre	4,000	1	2.4	1,382	3,400	2.4	555	1,250	1,350	3,000
Multi-Family										
1 storey/Prefab	10,000	24	1.9			1.9	400	900	TBD - based on number of units	
2 storey Townhouse	10,000	36	1.9			1.9	400	900	TBD - based on number of units	
3 - 4 storey Apartment / Condominium	6,500	60	1.9			1.9	400	900	TBD - based on number of units	
3 - 4 storey (Assist Living) Seniors Living	6,500	120	1.2			1.2	400	900	TBD - based on number of units	

The proposed land-use categories, minimum lot size, and population density per unit are from the proposed update to the DoL's OCP. The proposed water demands have been developed with allowances for indoor and outdoor water use. Indoor demand allowances are generally constant across most residential land-use categories. Outdoor water demand allowances generally vary based on the lot size and the percentage of the lot that could be greenspace which is based on typical land-use/zoning lot coverage percentages. The proposed residential demands decrease as the greenspace area decreases and the dwelling unit density increases.

3.2.2 Non-Residential (Institutional/Commercial/Industrial)

The DoL does have metering data from the relatively small number of non-residential properties (as shown in **Table 6)**. The types of businesses and activities that can take place within Institutional, Commercial, and Industrial (ICI) development vary widely, as do the required water demands and resulting sewage flows. For example, water demands are significantly different between the following activities:

- Institutional – school, church, public works yard
- Commercial – brew pub, restaurant, business office, retail store
- Industrial – food processing business, engine repair, mobile home manufacturing

The wide range of existing water demands for the properties within each of these categories within the DoL is graphically shown in **Figure 9**.

Because of the variability of potential water demands, each ICI development should be assessed independently with a detailed assessment of the average and maximum day water demands based on the proposed development.

Establishing standard ICI design demands for the DoL does not seem practical for the potential small number of ICI developments and the broad range of activities associated for each zone. These areas should be evaluated on a case-by-case basis, as a 'one-size fits all' approach may not be an effective approach for the DoL.

3.2.3 Peak Hour

The DoL does not have a peak hour demand design standard. Peak hour demand is used to assess the ability of the water distribution system to maintain an adequate (minimum 275 kPa {40 psi}) pressure to all customers during heavy demand conditions.

There are areas within the DoL that currently do not meet the minimum residual pressure during maximum day demands, and a more conservative value is warranted. Adopting a standard consistent with the City of Nanaimo standard of four times the average day flow is recommended.

3.2.4 System Redundancy

3.2.4.1 Water Supply Source

It is noted that other neighbouring communities that rely on groundwater well systems have back up water sources that can be utilized during heavy demand periods, which helps mitigate system risk if issues arise with their groundwater wells. If the DoL is considering lowering its standard to be more in line with its neighbours, then strong consideration must be given to developing a secondary source of water to provide a suitable backup that can be utilized in emergency

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Consulting Engineers

District of Lantzville
Non-Residential Metered Demands, 2014
(Institutional / Commercial / Industrial)

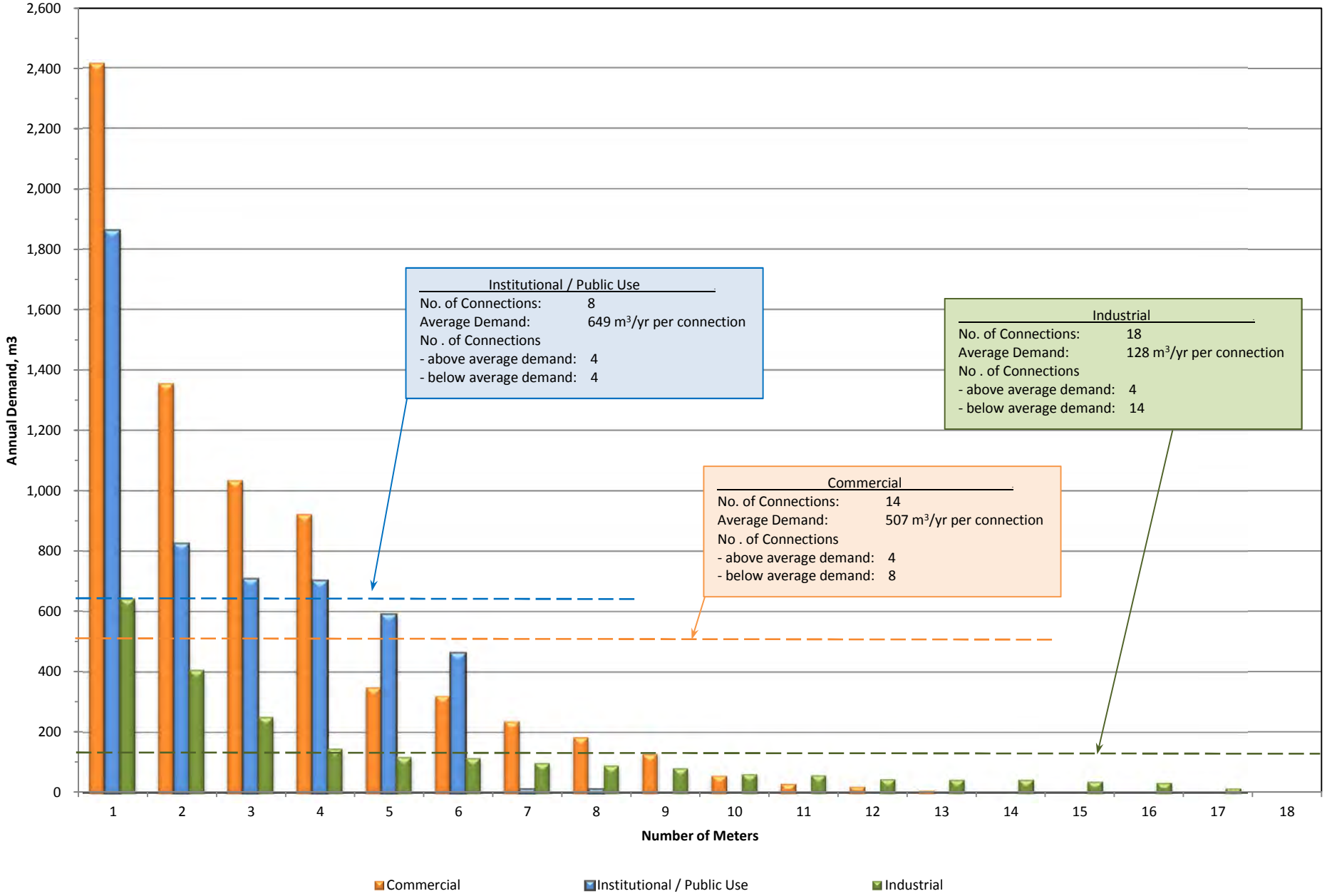

FIGURE 9

situations. The recent connection to the City of Nanaimo water system could provide a much needed alternate source in the event the wellfield is not available.

3.2.4.2 WATER RESERVOIR STORAGE VOLUME

It should be noted that both the City of Nanaimo and the City of Parksville have more storage within their distribution systems, which tends to provide buffering during periods of heavy demands and potential fire flow scenarios. Before considering revisions to the demand standards it is strongly recommended that the DoL improve storage capacity within their system, especially within the upper zone as noted in the 2015 report. The improved storage would help supply the system demands during a significant fire event, and lessen the strain on the DoL's well system, which are limited by a set pumping rate.

Increasing the volume of water stored in the distribution system should be a priority and implemented before expanding the DoL's water system to existing properties that are not yet serviced or before providing service to proposed new development.

The July 2015 report also recommended an evaluation of fire flow demands within the system (also addressed in the recent FUS report), which could influence potential reservoir sizing and system balancing criteria.

3.3 Climate Change

The "District of Lantzville Water Supply and Distribution Study, July 2015" (by KAEL) provided commentary on climate change and its potential impact on the DoL's water system. As such, we recommend that the DoL continue to monitor and assess system performance on a yearly basis and note trends in both groundwater behaviour and system consumption so that adjustments can be made if trends in supply availability or in average and maximum day usage start to shift. Future trends may require to the DoL to reassess its standards and introduce restrictions.

4 CONCLUSIONS

Based on the analysis in this report, the following conclusions are made.

1. Metering data shows that the DoL uses less water than outlined in its standard.

2. Comparison to consumption data in other jurisdictions indicates that the DoL uses less water on a per-capita basis.

3. An analysis of the system data shows that approximately 20% of the total system demand is for un-billed, or non-revenue water.

4. Residential use constitutes the largest percentage of water consumption within the DoL.

5. A comparison to standards in other local municipalities indicates that the DoL design standards are not the highest nor are they the lowest.

6. Using standards from neighbouring communities, like the Nanoose Peninsula (Fairwinds), City of Nanaimo, and City of Parksville as a comparison is considered prudent, as these areas share similar climatic and resident behaviour patterns, especially if the DoL is considering a connection to the City of Nanaimo water system.

7. The system improvements to increase storage capacity that have been recommended in previous reports are considered necessary before additional properties (existing or new) are serviced by the DoL's water system.

8. The development of a secondary, or redundant, water supply would be prudent and consistent with other neighbouring water supply systems that have adopted lower demand standards.

9. If the design standards are adjusted, continued monitoring and assessment of system use will track overall trends and help the DoL when assessing future changes.

10. Prevailing science on climate change indicates that the local Vancouver Island region will experience drier summers and wetter winters in the near future, and it would be prudent for the DoL to take these factors into consideration when developing their long range plans for infrastructure renewal and maintenance.

11. An analysis of the data indicates that larger lots tend to use more water on a per connections basis, most likely due to the increased use to irrigate the larger yards.

12. Based on the "smaller yard equals less water use per connection concept," there appears to be justification for a smaller per-capita water demand design standard for multi-family dwellings, since the need to irrigate is smaller on a proportional basis - i.e. less yard per resident. However, available local data is limited further analysis would be needed to present firmer recommendations.

5 RECOMMENDATIONS

Based on the findings in the report, it is recommended that the District of Lantzville:

1 Complete improvements to the DoL as noted in the July 2015 report, and confirm capacity through additional testing and monitoring as recommended in the LHC report before undertaking any revisions to the DoL's design demand standards.

2 Increase reservoir storage within the DoL as recommended in the July 2015 report before undertaking any revisions to the DoL's design demand standards.

3 Consider implementing additional water supply sources, such as the City of Nanaimo connection prior to adjusting the design standards.

4 Consider establishing the following range for water demand design standards for new developments serviced by the DoL's municipal water system as noted in Table 10, with higher target demands for larger acreage properties, specifically:

Single Family Residential

Average Day Demand: 510 litres per capita pd, or 1,100 to 1,300 litres per connection pd
Maximum Day Demand: 1,220 litres per capita pd, or 2,800 to 3,000 litres per connection pd
Peak Hour Demand: 2,000 litres per capita per day, or 4,800 litres per connection per day

Multi-Family

Average Day Demand: 400 - 450 litres per capita per day,
Maximum Day Demand: 900 – 1,000 litres per capita per day

5 Proceed with any changes to the design standards on an incremental basis, and only after improvements to the storage and supply system noted in recommendations 1, 2 and 3 are successfully implemented.

6 Continue to monitor system demand patterns and assess system performance on a yearly basis.

7 Continue to implement water conservation measures as they have shown to be effective in managing system demands.

8 Review water system performance on a regular basis and be prepared to make adjustments as conditions warrant. Continue to monitor ground water levels within the aquifer and track long term trends.

9 Re-rate the aquifer on a regular basis and be prepared to adjust standards if wellfield performance or water levels drops, especially if per-capita water use starts to increase.

10 Assess water demands for non-residential development (ICI) at the time of development and base design conditions on the proposed business/land-use activity and general good engineering best practises.

11 Keep abreast of ongoing climate change research and its potential impact on aquifer recharge rates, especially when making infrastructure policy decisions.

12 Maintain Bylaw No. 55. for properties that are outside the water service boundary noted in the OCP, and are not connected to the DoL's municipal water system, i.e., each new lot is provided with 3,400 L/day (0.5 igpm) of drinking water from a well (see Schedule C – Standards for Water Distribution Systems, Scope, Item 2).