The Impact of COVID-19 on Water Usage in the City of Long Beach

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Objective

In March 2020, a Safer at Home Order was declared in Long Beach in response to the COVID-19 pandemic. This led to the closing of many businesses and a large portion of the population staying at home. The purpose of this study is to understand the impacts of the COVID-19 pandemic on water use.

Data exploration and preparation

The data consists of 2018, 2019 and 2020 water use of approximately 90,000 accounts in Long Beach along with details on writing dates, rate, and lapse between writing dates.

Data challenges

a. A challenge with this data set is that meter reads do not only occur on the last day of each month and can occur on any day of the month. A meter read can happen during the middle of a month, July 15 for example, and therefore the water usage associated with that read is representative of the water used between the latter half of June and the first half of July.
b. Similarly, a meter may have a meter read date of July 1. In this case, even though the meter read date is in July, the associated water usage from that read is almost entirely June water use.
c. Some accounts may have a missing "monthly" read, so therefore the next read may be representative of water use for two "months". An example of this would be an account having a read on July 15, a blank read in August and another read on September 15. In this instance, the water use associated with the September 15 read would be the total water used between July 16 through September 15.

Data reformat Process

In order to make it easy to query and produce analysis/reports showing a continuous 3-year trend of water use for each individual account, the three separate data sets are joint by account number. In addition, the initial wide formatted data is converted into the long format.

In particular, the new joint data set is looking as follows

ACCT_NBR	WTR_RATE	WTR_READ_DT	WTR_USE	WTR_READ_DAYS	WTR_READ_MTH	YEAR	COUNT	ADJ_MTH_WTR_USE
1000000001	W-RDUPLX	12/16/2020	14	31	20-Dec	2020	1	10
1000000001	W-RDUPLX	11/15/2020	9	29	20-Nov	2020	2	8
1000000001	W-RDUPLX	10/17/2020	9	31	20-Oct	2020	3	8
1000000001	W-RDUPLX	9/16/2020	9	29	20-Sep	2020	4	9
1000000001	W-RDUPLX	8/18/2020	8	29	20-Aug	2020	5	11
1000000001	W-RDUPLX	7/20/2020	11	32	20-Jul	2020	6	12
1000000001	W-RDUPLX	6/18/2020	11	30	20-Jun	2020	7	12
1000000001	W-RDUPLX	5/19/2020	12	29	20-May	2020	8	12
1000000001	W-RDUPLX	4/20/2020	13	31	20-Apr	2020	9	12
1000000001	W-RDUPLX	3/20/2020	12	29	20-Mar	2020	10	12
1000000001	W-RDUPLX	2/20/2020	11	30	20-Feb	2020	11	12

Water use adjustments solution

As mentioned, the inconsistence in the water write dates makes the monthly water use data fluctuating and hence, it would be hard to produce accurate insights into our analysis on changes in monthly water use due to COVID-19.

To smooth out the trend lines for this time series data, I applied an averaging method with a window of 3 on the monthly use data. This process assumes all accounts were written in the middle of the month. For example, to calculate water use on 12/2020, you multiply 12/2020 data by ¼, the preceding month my ½, and 10/2020 by ¼.

Water Use (t) = ¼ *water use (t) + ½ * water use (t-1) + ¼ * water use(t-2)

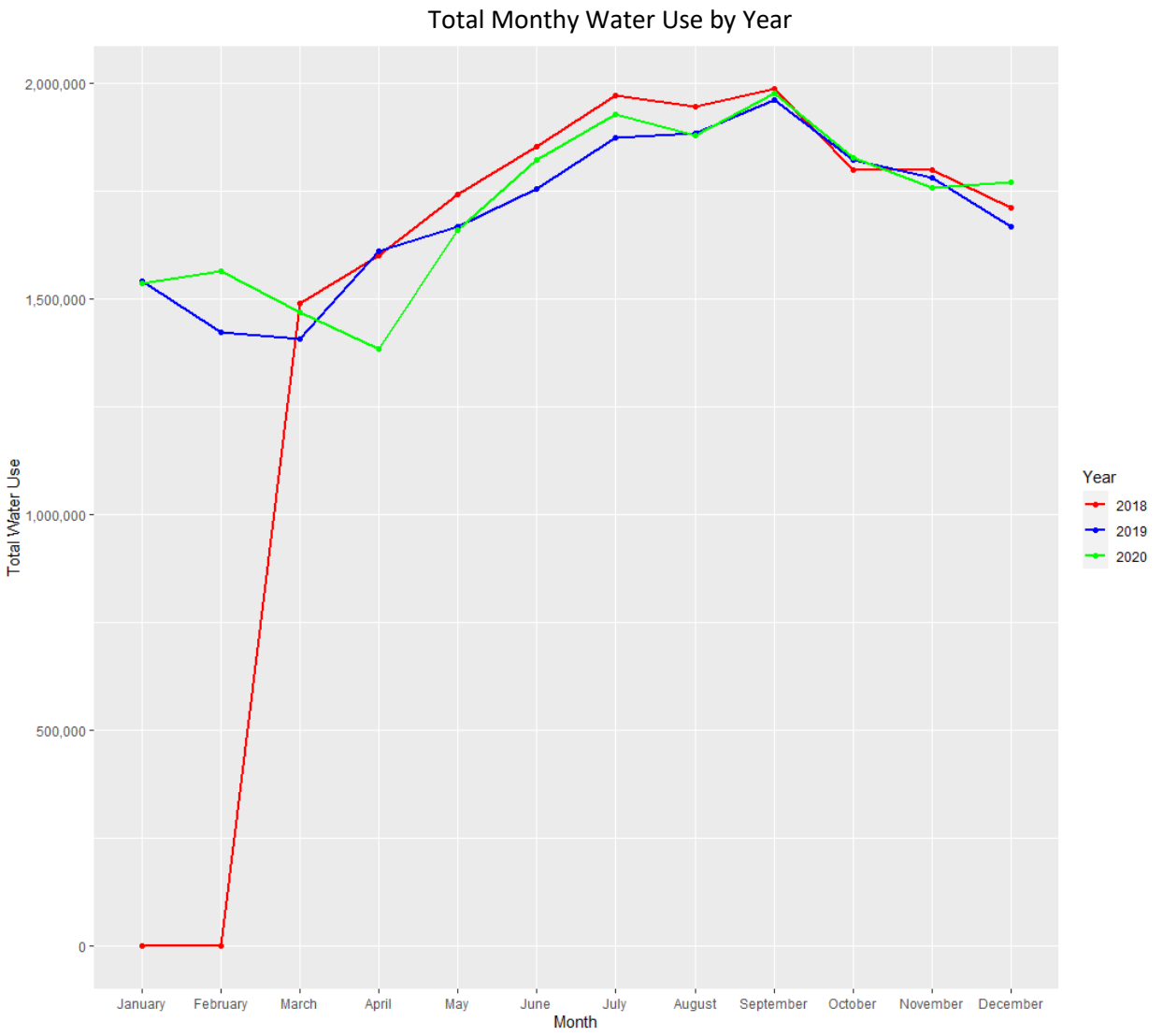
This could help spread out the water use data for missing writing dates.

A downside of this method is the first two months of 2018 have 0 as their records because the preceding months are out of scope for this dataset.

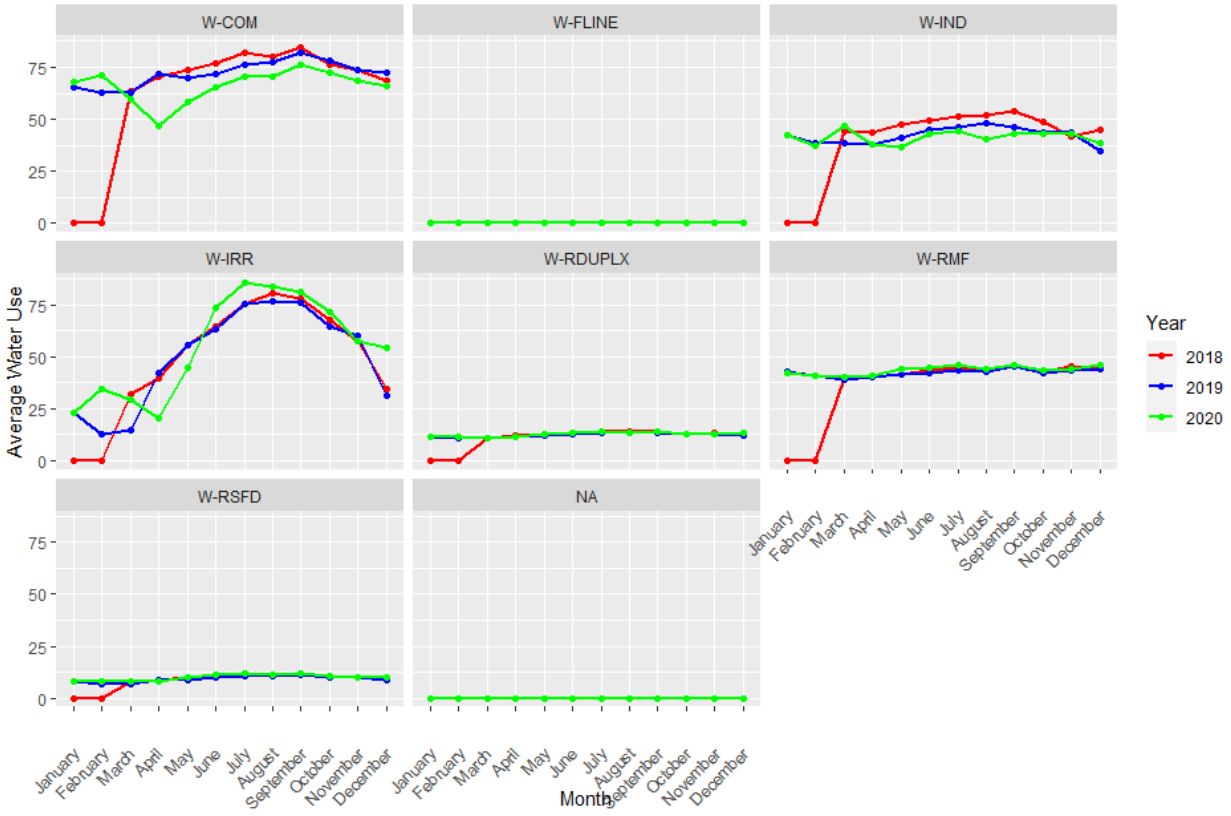
Key findings

1. In general, the total water use behaves similarly among the three years. We see an upward trend from January to September and then it is slightly going down toward yearend.
   In addition, 2018 has the high volume of water use for most month, there is no significant change from 2019 to 2020 except that there is a big drop in 04/2020, just right after the pandemic was announced.
   Looking at the aggregate usage of water across all rate types, there is barely a dramatic change in the monthly water use since COVID-19 was informed.

Month	2018	2019	2020
January	0	1543256	1538086
February	0	1423963	1565971
March	1489808	1407079	1469394
April	1601152	1611207	1385446
May	1744172	1668633	1660669
June	1853648	1756566	1821897
July	1972809	1875511	1927986
August	1946276	1884643	1879610
September	1986940	1961627	1978357
October	1799073	1823159	1828637
November	1798930	1781024	1759743
December	1711134	1668495	1771795



2. In terms of water use by rate type, COVID-19 has caused a more significant impact. There is a downtrend in Commercial and Irrigation rate type whereas residential types do not change much.



Row Labels	2018	2019	2020
W-COM	**763.1443266**	**871.1030552**	**802.5621883**
January	0	65.92100681	68.62156074
February	0	63.49137249	71.70635559
March	63.83895853	63.56767453	60.34465004
April	71.03359049	72.30647459	47.06017699
May	74.16473803	70.13281621	58.9842317
June	77.70106075	72.51812569	66.20305712
July	82.31195757	76.68972614	71.00337892
August	81.1444873	77.76776951	71.99758648
September	84.92478303	82.89773627	78.02461786
October	77.20475731	78.59411113	73.26934835
November	74.36547734	74.54551211	69.14384553
December	76.45451623	72.67072978	66.20337892
W-FLINE	**0**		**0**
W-IND	**479.9449153**	**511.4190871**	**500.0255319**
January	0	42.89626556	42.83404255
February	0	38.86307054	37.6
March	44.35169492	40.39419087	47.21276596
April	43.66101695	38.56846473	37.95319149
May	47.60169492	41.60995851	36.83404255
June	49.77118644	45.21991701	43.29787234

July	51.68644068	46.3526971	44.47659574
August	52.47033898	48.19502075	40.64680851
September	53.83898305	46.57261411	43.27659574
October	49.21186441	43.73858921	43.57446809
November	42.13559322	43.82987552	43.2212766
December	45.21610169	35.17842324	39.09787234
W-IRR	**588.6567944**	**603.2149613**	**664.2179156**
January	0	23.12037833	23.50645995
February	0	12.80825451	35.08440999
March	32.31968641	14.88907997	29.79758829
April	39.41463415	42.40412726	20.63652024
May	55.55139373	55.8116939	45.34280792
June	65.18989547	63.82287188	73.65374677
July	76.00958188	75.79621668	86.22652885
August	81.39372822	77.63800516	84.92764858
September	78.06097561	76.81255374	81.3583118
October	67.88937282	65.8383491	71.60809647
November	58.37020906	60.67927773	57.65633075
December	34.45731707	33.59415305	54.41946598
W-RDUPLX	**130.1454997**	**148.1012315**	**154.8881867**
January	0	11.68571429	11.52345649
February	0	10.8885468	11.39244045
March	11.17554314	10.67093596	11.1181332
April	11.94562384	11.64445813	11.64657268
May	12.72340161	11.93608374	13.19628099
June	13.41738051	12.69002463	13.79557608
July	14.37653631	13.48928571	14.24319397
August	13.91247672	13.34359606	13.76798736
September	13.93978895	13.70665025	14.30274672
October	12.67721912	12.74963054	13.17452601
November	13.32960894	12.72807882	13.18740885
December	12.64792055	12.5682266	13.53986388
W-RMF	**435.7135624**	**511.2870631**	**524.7450104**
January	0	42.82333941	42.17407867
February	0	40.80255094	41.05026915
March	40.01975432	39.37692563	40.33333333
April	40.50323705	40.52898791	41.08935818
May	42.23688579	41.92761305	44.1479089
June	44.07337317	42.57304953	44.55271222
July	45.27739044	43.76196786	46.24612836
August	44.20816733	43.33410634	44.22095238
September	46.05403386	45.52658605	46.36853002
October	43.21787849	42.86226603	43.74964803

November	45.85491368	43.49188339	44.57432712
December	44.26792829	44.27778698	46.23776398
W-RSFD	**101.1469**	**111.4784836**	**118.6981845**
January	0	7.945655971	7.860159149
February	0	6.945805679	8.046541175
March	7.880916667	6.926260459	7.859791367
April	8.657066667	8.515661127	7.825520746
May	9.93925	9.107440491	9.88194189
June	10.74225	9.918575445	11.08820088
July	11.66503333	10.87587538	11.71092313
August	11.51478333	10.97709467	11.31333378
September	11.48456667	11.25170917	11.88979906
October	10.10583333	10.28865379	10.75285031
November	9.99075	9.989087945	10.13368886
December	9.16645	8.736663506	10.33543415