



## Memorandum

*To: Brian Davis, Metropolitan Council*

*From: Bill Davis, Jodi Polzin, CDM Smith*

*Date: November 10, 2017*

*Subject: Water Efficiency Project - Preliminary Community Screening*

This memo outlines the data processing steps used to screen municipal water systems ("communities") to identify potential candidate communities for economic analysis of potential peak demand reduction.

The objective of the community screening process is to identify municipal water systems with the following characteristics:

- A high percentage of residential water use
- A high residential gallon per capita per day (gpcd) rate of use
- A high summer peak month to winter average water use ratio
- A high projected population growth from 2017 to 2040
- A high number of estimated new wells needed by 2040

This memorandum describes the data and process to screen communities for these five characteristics.

### **Data Sources**

Four data files were provided by Metropolitan Council for use in this screening process:

1. **MPARS\_Inventory\_20170607.xlsx** – This file contains 584 records in which each record represents an annual report for a water system. The data fields include:
  - Permit Number
  - Landowner Name
  - County
  - Year
  - Population Served

- Maximum Day Volume
  - Maximum Day Date
  - Reported Water Use (total volume)
  - Total Gallons Delivered
  - Residential Gallons Delivered
  - Residential Connections:
    - *Residential Metered Connections*
    - *Resource Type (groundwater, lake, stream/river)*
    - *Use Type (municipal/public water supply, private water supply, commercial/institutional water supply)*
2. MPARS\_**Monthly**\_20170607.xlsx – This file contains 130,690 records in which each record represents an annual report for a water withdrawal point. The data fields include:
- Permit Number
  - Year
  - January Gallons through December Gallons
  - Installation Total (annual total in million gallons)
  - Major Use Category (industrial, irrigation power generation, water supply)
  - Resource Type (groundwater, lake, stream/river)
  - County
  - Latitude & Longitude of withdrawal point
3. Thrive-MSP-2040-Forecasts-(January-2017).xlsx - This file contains **population**, housing and employment projections for municipalities and counties within the Metropolitan Region. The data are for the years 2010, 2020, 2030 and 2040.
4. MDH **Well** database – This database consists of multiple Excel files downloaded from the MDH database. The two files, and the related data, used for this analysis are:
- PWS.xls – contains Name of Community and PWS ID number
  - FACILITY.xls – contains the PWS ID number, Facility Code (WL for well), Availability Code (PRIM for primary, EMER for emergency) for each well.

From this data, the PWS number can be identified in the PWS file for each community of interest and used to identify wells listed in the Facility file for the communities of interest. Well data from the Facility file is selected for primary wells only, excluding emergency wells, and a count of the number of wells per community is determined.

### **Screening Criteria**

The screening process began with data from the **Inventory** file. CDM Smith added four new fields to the database:

- Municipal System (yes or blank)
- Groundwater (yes or blank)
- Percent Residential by Volume (residential delivered/total delivered)
- Residential GPCD (residential delivered/population served)

Only records for systems that are municipal systems were selected for further screening. The screening also excluded systems that relied on purchased water. Note that the City of Medina has three permit numbers and White Bear Township has two permit numbers. The data, by permit number, were merged for each of these communities. Each municipal system has from 1 to 4 records for the years 2013 to 2016. The values for population served, total delivery volume, and residential delivery volume were averaged across all available years for each municipal system. The percent residential volume and the residential GPCD were calculated from the averages for each system. There are 100 municipal systems that meet the criteria of municipal systems on groundwater. Those that provide wholesale water to other systems were excluded leaving 94 systems as potential communities. (A list of known interconnections among systems is included at the end of this memo.)

The data for these 94 systems were sorted by percent residential and residential GPCD to identify communities that best meet the first two selection criteria. The percent residential by volume ranges from 99 percent to 23 percent. The residential GPCD ranges from 124 to 27 GPCD.

The second step was to analyze the Monthly water use data. A table was created from the Inventory data that included the permit number and name of the 94 selected systems. This table was used as a lookup table to pull out the monthly water use records for these systems.

In the prior analysis using this database with respect to water billing rates, only the data since the year 2000 was used. This same assumption was applied to the current analysis, which reduced the number of records representing water withdrawals by withdrawal point (well) for the 94 systems. The monthly water withdrawal volumes by withdrawal point (well) were summed for each system for each year. This resulted in 17 annual records for most of the systems. For the two systems with less than 17 years of data, both had at least eight years (2009-2016) of data available.

The water withdrawals by month were averaged by month across all available years for each system. From these monthly averages, the following data were calculated:

- The maximum month volume
- The winter average volume (average of October – April)
- The ratio of maximum month volume to the winter average volume

Note that these calculations of the peak month ratio are based on a longer time period (2000-2016) than the time period (2013-2016) used in the computation of the percent residential volume and residential GPCD. A comparison calculation of the peak month ratios was conducted using only the 2013-2016 period and found that in general the ratios were lower. Further investigation revealed that many of the system peak month volumes occurred during a period from about 2003 to 2008. Therefore, the peak month ratios from the 17-year data were used in the analysis.

The peak month to winter ratio of each system was matched to the summary data from the **Inventory** file by permit number. This information allows the 94 communities to be sorted by the peak month to winter ratio with respect to the third selection criteria.

One system (the City of Lexington in Anoka County with an average population served of 2,062) has a peak ratio of 68. Review of the **monthly** withdrawal data for this system indicates that Lexington purchases water from Blaine and only uses its well to supplement water for higher summer demand. Thus, the winter average used to calculate the ratio was extremely low. With the exception of this one system, the peak ratios of the systems range from 4.1 to 1.3.

The third step in the process was to identify the future population growth percentage for the 94 systems. The **population** data is by municipality rather than by water system. The data are organized by county and then municipality. Some municipalities are partially listed in two counties. For these municipalities, the two populations were combined to represent the entire municipality.

The municipality names in the population data were matched with the municipal water system names from the MPARS data. The population values for 2010 and 2040 were used to calculate the population growth for each of the communities. The growth ranged from 59,032 (St. Paul Regional Services) to -126 (City of Lakeland).

The fourth step in the process was to approximate the number of new wells each community would need by 2040. The MDH **well** data was used to derive the current number of active wells (excluding emergency wells). The population served by each community was divided by the number of wells to estimate the ratio of population served per well. The change in population from 2010 to 2040 was divided by this ratio to estimate the number of future new wells needed for each community. This assumes that the ratio of population per well remains the same, and that all new water supply will be provided from new wells. The resulting estimate of new wells needed was rounded to the nearest integer. Almost a third (30) of the communities do not appear to need new wells in the future. Two communities (Lake Elmo and Dayton) may need as many as 9 new wells by 2040 given their current ratio of population per well and projected population growth.

### **Ranking, Scoring, and Recommendation**

Two further steps were used to rank and score the communities with respect to the five criteria. The list of communities was sorted for each of the criteria: percent residential use, residential GPCD, peak ratio, total population growth, and number of new wells. Each time the list was ranked, a rank order was assigned to the communities, ranging from 1 to 94. Each time the list was sorted the values of the top 20 communities of that criteria was highlighted.

Note that for most criteria, the communities were ranked in order from 1 to 94. However, for the number of new wells criterion, which was an integer from 0 to 9, there were multiple “ties” for each level. For example, the two communities with 9 new wells were both ranked “1”, then the three communities with 8 new wells were all ranked “3”, the communities with 7 new wells were all ranked “6”, etc.

The overall ranking value (score) of each community was calculated as a sum of the five ranking numbers. Thus, the score values have a potential range from 5 (5 x 1) to 470 (5 x 94). A low score corresponds to a higher preference for assessment of water efficiency potential. The actual scores of the communities ranged from 67 up to 399. As currently calculated, each criterion carries the same weight in determining the overall score. Thought was given to the possibility of weighting the individual criteria in the calculation of the score. However, it was decided that any weighting scheme would impose some level of subjectivity into the selection process. Interestingly, a few tests of alternate weighting schemes resulted in only relatively minor changes in the final ranking. Depending upon which criterion had the most weight, one or two communities would be shifted in or out of the top 20 communities. The final (non-weighted) listing of communities by overall score is shown in Table 1.

Based on this analysis, the top 20 communities in Table 1 are recommended as candidates for analysis of potential benefits of implementation of a water efficiency program as compared to expansion of water supply to meet future growth needs. It is anticipated that up to 5 communities will be decline the opportunity to participate in the next phase of this study. Therefore, the final analysis will be conducted on 15 of the potential 20 communities.

**Table 1. Summary of Community Rankings by Criteria and Overall Ranking by Score**

RANK	MPARS Name	Avg. Pop. Served	Weight	Avg. %RES by Vol	1	1	Growth Rate	Change 2010-2040	1	Peak Ratio	1	# New Wells	1	Weighted Score
					Rank %RES	Avg. RES GPCD			Rank RES-GPCD		Rank Pop Change		Rank by Peak	
1	Andover	19,572	88%	14	107.6	3	37%	11,302	24	4.11	1	3	25	67
2	Minnetrista	3,318	84%	23	99.2	5	88%	5,616	41	3.75	2	8	3	74
3	Prior Lake	24,438	93%	4	76.8	20	69%	15,394	11	2.71	22	4	17	74
4	Woodbury	66,451	82%	30	83.6	10	42%	25,839	5	3.07	13	4	17	75
5	Rosemount	23,143	80%	32	78.6	14	74%	16,126	9	3.06	14	6	11	80
6	Carver	4,219	90%	11	68.1	38	316%	11,776	20	3.01	16	8	3	88
7	Victoria	8,009	89%	12	77.3	19	110%	8,055	33	3.38	5	3	25	94
8	Eden Prairie	62,628	74%	45	80.5	12	36%	21,603	7	2.79	21	5	12	97
9	Hugo	11,380	79%	34	63.5	51	118%	15,668	10	3.24	6	7	6	107
10	Lake Elmo	3,465	77%	41	72.2	29	126%	10,139	30	3.2	8	9	1	109
11	Chanhassen	24,639	77%	40	78.4	15	62%	14,148	14	2.67	28	5	12	109
12	Maple Grove	68,279	72%	54	79.6	13	46%	28,133	3	2.69	25	4	17	112
13	Cottage Grove	34,056	83%	25	72.8	27	36%	12,411	19	2.7	24	4	17	112
14	Farmington	22,421	91%	7	69	35	54%	11,414	23	2.58	31	4	17	113
15	Rogers	9,330	65%	76	90.9	6	104%	11,603	22	3.48	4	7	6	114
16	Lakeville	59,027	85%	21	56.2	69	49%	27,546	4	2.95	19	7	6	119
17	Lino Lakes	15,517	82%	28	68.1	37	54%	10,884	26	3.13	11	4	17	119
18	Brooklyn Park	78,312	77%	37	76.1	21	29%	22,119	6	2.37	42	3	25	131
19	Ramsey	12,682	60%	85	78.2	16	47%	11,032	25	3.71	3	7	6	135
20	Apple Valley	50,450	71%	56	72.2	28	30%	14,516	12	2.66	29	5	12	137
21	Empire Twp.	2,284	87%	16	73	25	98%	2,386	56	3.23	7	2	38	142
22	St Francis	5,161	86%	19	75.5	24	75%	5,382	42	2.54	35	3	25	145
23	Plymouth	73,748	75%	43	75.8	23	18%	13,024	16	2.38	41	3	25	148
24	Shakopee	39,392	60%	84	67.8	41	44%	16,154	8	3.05	15	8	3	151
25	Blaine	62,266	67%	69	68.1	39	53%	30,114	2	2.67	27	3	25	162
26	Dayton	1,274	90%	10	64.7	48	125%	5,783	39	1.95	65	9	1	163
27	Savage	28,867	71%	55	57.8	67	53%	14,189	13	3.08	12	3	25	172
28	Shorewood	3,788	89%	13	89.4	8	4%	293	80	3.16	10	-	64	175
29	Eagan	66,398	68%	66	78	17	13%	8,094	32	2.49	36	3	25	176
30	Vadnais Hts.	12,013	93%	5	90.3	7	15%	1,798	59	2.34	43	-	64	178
31	Champlin	23,207	88%	15	82.3	11	4%	911	69	2.81	20	-	64	179
32	Coon Rapids	62,476	99%	2	43.4	88	17%	10,624	27	2.67	26	2	38	181
33	Mnnetonka	51,095	67%	67	75.9	22	24%	11,766	21	2.13	56	4	17	183
34	Waconia	11,421	74%	46	61.9	56	124%	13,303	15	1.98	62	5	12	191
35	Stillwater	18,663	75%	44	77.6	18	25%	4,573	45	2.23	53	2	38	198
36	Hastings	22,509	78%	36	70	33	30%	6,628	35	2.27	51	1	48	203
37	Edina	47,941	67%	70	87	9	13%	6,459	36	2.31	45	1	48	208
38	Mntka. Beach	566	79%	33	120.6	2	-5%	-29	92	3	17	-	64	208
39	Elko New Market	4,408	74%	49	46	86	190%	7,790	34	2.54	34	5	12	215
40	Medina	3,869	51%	90	55.2	71	72%	3,508	48	3.18	9	7	6	224
41	Marine St. Croix	105	99%	1	71	32	36%	251	83	1.84	71	2	38	225
42	Inver Grove Hts.	35,125	74%	47	50.1	82	38%	12,820	18	2.11	57	3	25	229
43	Forest Lake	10,513	66%	71	68.8	36	57%	10,523	28	1.78	75	3	25	235
44	Cologne	1,519	78%	35	58.1	66	157%	2,391	55	2.18	54	3	25	235
45	Fridley	27,675	74%	48	45.5	87	19%	5,292	44	3	18	2	38	235
46	Oakdale	27,976	77%	39	65.7	46	10%	2,799	51	2.24	52	1	48	236
47	Mayer	1,840	94%	3	59.1	61	69%	1,201	63	1.99	61	1	48	236
48	Tonka Bay	1,475	86%	18	72.9	26	6%	85	87	2.27	48	-	64	243
49	Mahtomedi	7,600	85%	20	72.1	30	0%	24	89	2.38	40	-	64	243
50	Randolph	322	71%	57	124.3	1	-4%	-16	91	2.61	30	-	64	243
51	Wayzata	3,907	64%	78	107.1	4	26%	962	68	2.31	46	1	48	244
52	Chaska	24,100	46%	91	53.9	74	54%	12,830	17	2.39	39	3	25	246
53	Centerville	3,845	91%	8	59.1	62	7%	268	82	2.57	32	-	64	248

54	Brooklyn Center	30,104	73%	52	64.3	50	18%	5,296	43	1.93	66	2	38	249
55	Bloomington	86,342	61%	81	69.6	34	13%	10,407	29	2.07	59	1	48	251
56	Norwood YA.	3,637	83%	26	51.2	79	159%	5,651	40	1.52	86	3	25	256
57	Circle Pines	4,974	87%	17	63.3	52	8%	382	76	2.3	47	-	64	256
58	Orono	2,970	65%	75	61.1	57	28%	2,063	57	2.56	33	2	38	260
59	Burnsville	61,027	55%	88	63.3	53	14%	8,194	31	2.18	55	2	38	265
60	Spring Lake Pk.	6,453	70%	61	67.8	40	15%	988	67	2.27	49	1	48	265
61	Anoka	17,673	62%	80	65.9	44	24%	4,058	47	2.27	50	1	48	269
62	Shoreview	27,550	73%	50	63	54	2%	557	72	2.48	37	-	64	277
63	Watertown	4,239	81%	31	54.4	72	71%	2,995	49	1.59	81	1	48	281
64	Robbinsdale	14,018	90%	9	60.4	59	10%	1,347	61	1.49	89	-	64	282
65	White Bear Lake	24,163	75%	42	63	55	8%	2,003	58	1.95	64	-	64	283
66	Mounds View	12,155	77%	38	66	43	2%	245	84	1.98	63	-	64	292
67	Greenfield	259	23%	94	26.5	94	40%	1,103	65	2.71	23	4	17	293
68	Lakeland	2,804	84%	24	55.3	70	-7%	-126	94	2.33	44	-	64	296
69	Jordan	6,238	71%	58	46.3	84	81%	4,430	46	1.81	73	2	38	299
70	White Bear Twp.	13,685	70%	60	58.8	63	5%	551	74	2.41	38	-	64	299
71	St Louis Park	47,386	64%	79	60.5	58	13%	6,050	37	1.6	80	1	48	302
72	St Anthony	8,226	73%	51	65.7	45	7%	574	71	1.83	72	-	64	303
73	St Bonifacius	2,324	82%	29	64.5	49	-5%	-113	93	1.89	68	-	64	303
74	Belle Plaine	6,707	65%	74	51.2	80	89%	5,939	38	1.75	76	2	38	306
75	Hopkins	18,345	70%	63	65.4	47	14%	2,509	54	1.57	82	-	64	310
76	Vermillion	923	92%	6	33.1	92	0%	1	90	2.07	58	-	64	310
77	St Paul Park	5,338	68%	65	54.2	73	50%	2,627	53	1.81	74	1	48	313
78	St Paul RWS	435,000	42%	93	32.8	93	21%	59,032	1	1.51	87	1	48	322
79	Mound	9,255	84%	22	51.9	76	4%	348	78	1.54	85	-	64	325
80	Lexington	2,062	83%	27	60.1	60	19%	381	77	68.36	99	-	64	327
81	Oak Park Hts.	4,707	54%	89	58.6	64	28%	1,255	62	1.88	69	1	48	332
82	Excelsior	2,210	67%	68	71.8	31	11%	232	85	1.54	84	-	64	332
83	New Brighton	22,093	56%	87	67.7	42	12%	2,644	52	1.31	93	-	64	338
84	North St Paul	13,266	73%	53	51.3	78	5%	540	75	1.88	70	-	64	340
85	Richfield	36,098	69%	64	51.5	77	2%	672	70	1.73	78	-	64	353
86	Loretto	650	71%	59	53.1	75	8%	50	88	1.9	67	-	64	353
87	Bayport	3,686	65%	77	43	89	34%	1,169	64	1.75	77	1	48	355
88	New Prague	7,410	66%	72	50.5	81	68%	2,920	50	2	60	-	94	357
89	Spring Park	1,762	66%	73	58.3	65	17%	281	81	1.57	83	-	64	366
90	Newport	3,435	61%	82	46.1	85	30%	1,015	66	1.46	90	1	48	371
91	New Germany	393	70%	62	41.1	90	88%	328	79	1.35	92	1	48	371
92	Long Lake	1,760	59%	86	56.9	68	13%	222	86	1.65	79	-	64	383
93	South St Paul	20,280	42%	92	49.3	83	8%	1,640	60	1.39	91	-	64	390
94	Maple Plain	1,984	61%	83	34.9	91	31%	552	73	1.5	88	-	64	399

XXX denotes communities with combination of groundwater and surface water supplies.

YYY denotes communities within top 20 of identified criterion

ZZZ denotes potential error in data

**Table 2 – Communities that Purchase Water**

Community	Purchases from
Arden Hills	St. Paul
Birchwood Village	White Bear Lake
Columbia Heights	Minneapolis
Crystal	Minneapolis
Deephaven	Minnetonka and Shorewood
Falcon Heights	St. Paul
Fort Snelling	Minneapolis
Golden Valley	Minneapolis
Greenwood	Excelsior
Hilltop	Minneapolis
Lake St. Croix Beach	Lakeland
Lakeland Shores	Lakeland
Landfall	Oakdale
Lauderdale	St. Paul
Lilydale	St. Paul
Little Canada	St. Paul
Maplewood	North St. Paul and St. Paul
Mendota	St. Paul
Mendota Heights	St. Paul
New Hope	Minneapolis
North Oaks	White Bear Township
Osseo	Maple Grove
Roseville	St. Paul
Sunfish Lake	St. Paul
West St. Paul	St. Paul
Willernie	Mahtomedi
Woodland	Minnetonka