

# Memo

**Date:** November 20, 2018  
**To:** Kevin Stewart  
**From:** Markus Ritsch  
**Subject:** October 2018 ALERT Data Analysis

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## I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's NovaStar 5 base station were analyzed for the period October 1 through October 31, 2018.

## II. General System Analysis Summary

The District receives data through both the legacy ALERT channel and through the ALERT2 (concentrator plus A2 self-reports) channel. The following quantifies the data reports received by each channel at Diamond Hill (Table 1).

**Table 1. Reception of Data at Diamond Hill (Legacy, ALERT2 and Concentrator Reports from Recdatalog)**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Legacy ALERT (line 1)	208,189	170,938	214,572	224,711	215,631	215,515	228,428	217,039	192,724	198,651			2,086,398
DHill Conc (line 2)	369,547	328,399	383,229	359,855	327,392	365,225	380,878	369,881	343,040	343,918			3,571,364
DHill ALERT2 (line 4)	608,216	474,112	513,779	511,112	563,921	562,145	578,579	574,552	557,204	522,071			5,465,691
Westy ALERT2 (line 8)		472,878	513,257	549,423	601,462	560,429	524,276	573,128	549,992	521,620			4,866,465
Westy Conc (line 6)		327,438	382,812	386,882	382,751	364,046	343,901	368,820	338,472	343,567			3,238,689
<b>TOTAL</b>	<b>1,185,952</b>	<b>1,773,765</b>	<b>2,007,649</b>	<b>2,031,983</b>	<b>2,091,157</b>	<b>2,067,360</b>	<b>2,056,062</b>	<b>2,103,420</b>	<b>1,981,432</b>	<b>1,929,827</b>	<b>0</b>	<b>0</b>	<b>19,228,607</b>
Con/Leg	1.78	1.92	1.79	1.60	1.52	1.69	1.67	1.70	1.78	1.73	0.00	0.00	1.71
DataChr	713,367	590,020	715,298	743,578	765,183	735,108	747,353	749,605	711,716	691,389			7,162,617

A new ALERT2 receiver/decoder was installed in Westy, Colorado in January of 2018. This redundant data feed was added to NovaStar5 in late January. The new data feeds (lines 6 and 8) were added to both the Diamond Hill base station and to the Greenhouse base station for backup. Data from this new source will be quantified as part of this report.

The District operates two NovaStar5 base stations: the primary (ns5a) at Diamond Hill and a redundant base (ns5b) at Greenhouse Data. Additional analyses are conducted on the data received by these two base stations (Table 2). The data received by both base stations for the month are shown below.

The battery charger powering the ALERT2 decoder at Diamond Hill failed on April 22, 2018. The charger was replaced by OneRain on April 26, 2018. The number of ALERT2 and concentrator reports through Diamond Hill is decreased in April due to the failure of the battery charger. The ratio between legacy reports and concentrator reports is also decreased for these four days.

Network issues were present that degraded data collection on the Greenhouse server between July 2 and July 9, 2018. An uninterruptable power supply (UPS) malfunctioned around July 2 which caused a network switch to go down at Diamond Hill. The network was fully restored on July 9.

Network issues at the District were encountered that degraded data collection between September 11 through September 13<sup>th</sup>. Network issues at the Westy ALERT2 decoder were evident on September 20<sup>th</sup>. All network issues were resolved.

**Table 2. Comparison of Data Reception by ns5a and ns5b**

<b>NS5A (Diamond Hill)</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>	<b>Tot</b>
Legacy	208,189	170,938	214,572	224,711	215,631	215,515	228,428	217,039	192,724	198,651			2,086,398
Concentrator	369,547	328,399	383,229	359,855	327,392	365,225	380,878	369,881	343,040	343,918			3,571,364
ALERT2	608,216	474,112	513,779	511,112	563,921	562,145	578,579	574,552	557,204	522,071			5,465,691
Westy (Conc)		327,438	382,812	386,882	382,751	364,046	343,901	368,820	338,472	343,567			3,238,689
Westy (A2)		472,878	513,257	549,423	601,462	560,429	524,276	573,128	549,992	521,620			4,866,465
<b>NS5B (Greenhouse)</b>													
Legacy	207,991	167,936	176,780	223,474	212,628	213,434	226,850	217,135	192,702	202,174			2,041,104
Concentrator	369,370	297,198	289,542	357,805	322,706	361,904	367,354	368,785	342,499	345,176			3,422,339
ALERT2	608,348	437,957	389,787	510,718	557,093	557,214	559,618	573,486	556,396	524,000			5,274,617
Westy (Conc)		304,809	292,048	386,008	382,805	361,518	367,720	368,477	338,261	344,298			3,145,944
Westy (A2)		446,873	398,421	548,228	601,760	556,688	560,820	572,515	549,753	522,704			4,757,762
<b>Diff (NS5a-NS5b)</b>													
Legacy (Digi One)	198	3,002	37,792	1,237	3,003	2,081	1,578	-96	22	-3,523	0	0	45,294
Concentrator (B2010)	177	31,201	93,687	2,050	4,686	3,321	13,524	1,096	541	-1,258	0	0	149,025
ALERT2 (B2010)	-132	36,155	123,992	394	6,828	4,931	18,961	1,066	808	-1,929	0	0	191,074
Westy (Conc)	0	22,629	90,764	874	-54	2,528	-23,819	343	211	- 731	0	0	92,745
Westy (A2)	0	26,005	114,836	1,195	-298	3,741	-36,544	613	239	-1,084	0	0	108,703
Comments		Network issues experienced this month at DH	New line numbers were assigned at GH	Data script updated									

The daily ratio of concentrator to legacy reports is shown (Figure 1).

In March, the system configuration for data reception at Greenhouse was changed so that unique line numbers could be used to quantify data reports received uniquely at each base station. The automated script used to quantify reports was not updated until April. That’s why the large discrepancy in reporting was quantified in March between Diamond Hill and Greenhouse. The new line numbering convention is as follows:

**Primary Node Diamond Hill Base Station**

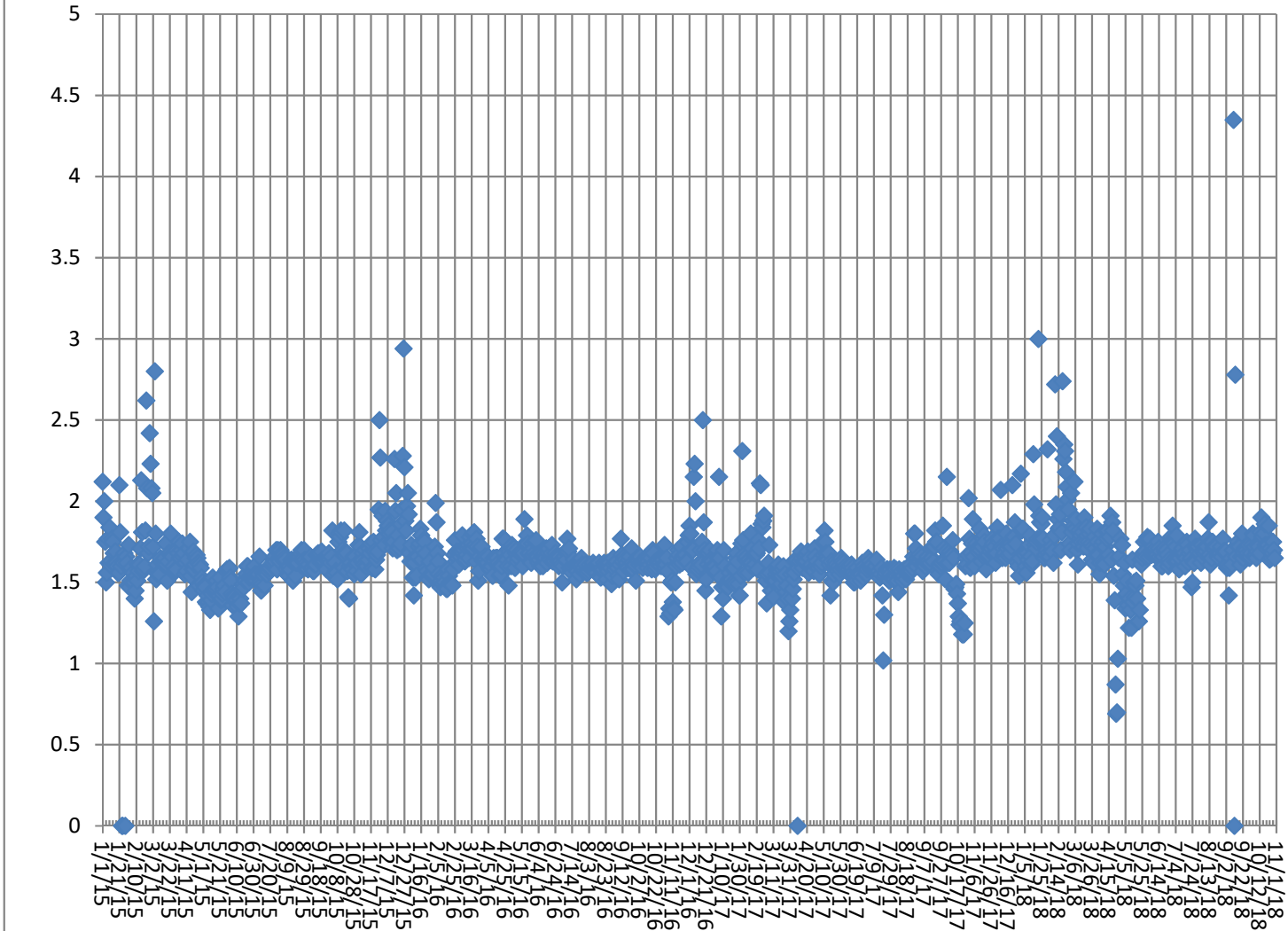
- ) Line 1 = Legacy ALERT
- ) Line 2 = Concentrator from Diamond Hill Decoder
- ) Line 4 = ALERT2 from Diamond Hill Decoder
- ) Line 6 = Concentrator from Westminster Decoder
- ) Line 8 = ALERT2 at Westminster Decoder

**Backup Node Greenhouse Base Station**

- ) Line 1 = Legacy ALERT
- ) Line 3 = Concentrator from Diamond Hill Decoder
- ) Line 5 = ALERT2 from Diamond Hill Decoder
- ) Line 7 = Concentrator from Westminster Decoder
- ) Line 9 = ALERT2 at Westminster Decoder

**Figure 1. Daily Ratio of Concentrator Reports to Legacy Reports**

## Ratio of Concentrator/Legacy for 2015, 2016, 2017, 2018



The ratio becomes more volatile in the cold months as the Blue Mountain repeater has problems with legacy ALERT reporting when the temperature drops below zero.

The ratio on January 21, 2018 was very high with a value of 3. The system experienced a significant decrease in legacy ALERT reports on this day. The loss of ALERT legacy reports on January 21, 2018 are from Blue Mountain, Elbert, Urban Farm, and Marston Lake North. The most likely explanation is that the legacy ALERT output from the Blue Mountain repeater was down due to the cold weather experienced on both January 21 and January 15.

A cold spell in February likely contributed to the higher than expected ratio of concentration to legacy reporting.

The failure of the battery charger at the Diamond Hill ALERT2/Concentrator decoder for the period April 22 through April 26 is evident in the decreased ratios for these days.

Decoder issues at the District were encountered that degraded data collection from the legacy ALERT feed between September 11 through September 13th. Additionally, network issues during the same period affected the collection of both ALERT1 and ALERT2 data during the period September 11 through September 13<sup>th</sup>. These issues were resolved by September 13<sup>th</sup>. The ALERT legacy decoder was power cycled to fix the problem.

## A. Continuous Operation of Base Receiver/Decoder

Data was collected on a continuous basis for a total of 744 hours of operation. Outages of less than one hour are not identified.

## B. Specific Issues Identified

Performance of the following sensors (Table 3) was questionable this month.

**Table 3. Sensors with Poor Performance Characteristics**

Sensor ID	Description	Comments
2101	Unknown	Concentrator received 1,510 reports from this ID with SA 9001
4870	SBC @ SB Road	High amount of invalid data that isn't getting flagged
2803	Columbine Open Space	High latency and large amount of invalid data
3050	East/West Trailhead	Had the highest and lowest latency
0, 1, 2	Unknown	Unknown IDS transmitted on legacy ALERT

## C. ALERT2 Repeater Loading

The District's ALERT2 architecture utilizes 5 repeaters with a single transmit frequency (170.300 MHz) to Diamond Hill. The repeaters utilize a 20 second frame where each repeater is allocated a slot of specific size and an offset within the frame. The slot allocated to each repeater is sized appropriately to accommodate the total number of existing and future remote sites routed through that repeater. Each repeater is shown along with its designated slot (Table 4). Currently there is no pass-listing for the ALERT2 repeaters. Any remote ALERT2 site can be received by all repeaters and re-broadcast to the base except for West Creek which has an input frequency unique to Douglas County.

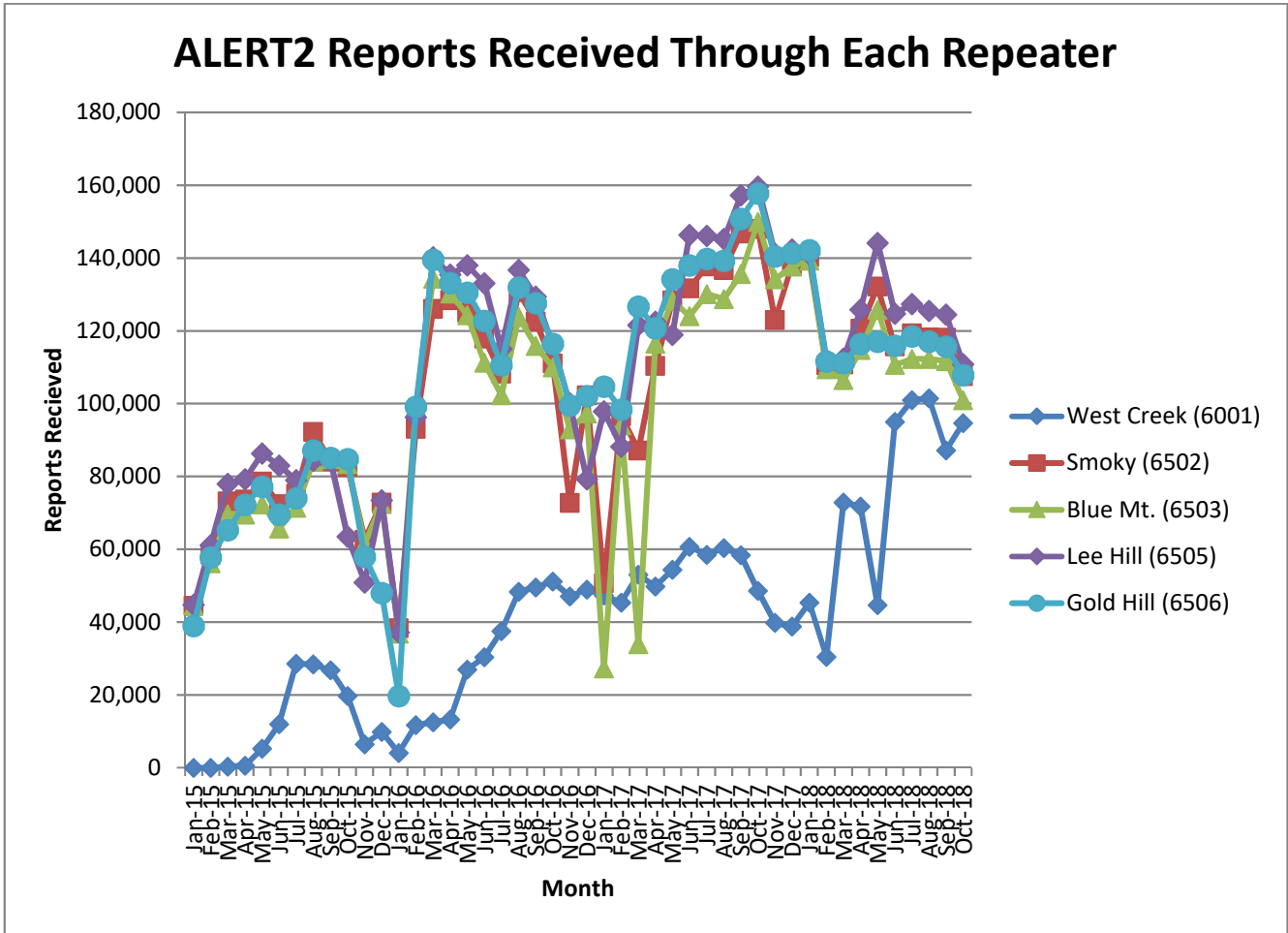
**Table 4. ALERT2 Repeater Architecture**

Repeater	Slot Size (sec)	Slot Offset (sec)	Source Address	ALERT2 Input Frequency (MHz)	ALERT2 Output Frequency (MHz) – received at Diamond Hill
West Creek	2	0	6001	169.425	170.300
Smoky	3	2	6502	169.525	170.300
Blue Mt.	4	5	6503	169.525	170.300
Lee Hill	3	9	6505	169.525	170.300
Gold Hill	3	12	6506	169.525	170.300
Magnolia	5	15	6507		170.300
Frame Size	20				

The following tables summarize the total number of reports received through each repeater (Table 5). This helps to quantify repeater loading for the ALERT2 backbone.

**Table 5. ALERT2 Reports Received through Each Repeater (Only A2 Self Reports)**

<b>Month-Yr</b>	<b>West Creek (6001)</b>	<b>Smoky (6502)</b>	<b>Blue Mt. (6503)</b>	<b>Lee Hill (6505)</b>	<b>Gold Hill (6506)</b>	<b>TOTAL</b>
Jan-15	0	44,501	44,636	44,783	39,007	172,927
Feb-15	0	58,543	56,150	61,160	57,764	233,617
Mar-15	346	73,198	69,604	77,968	65,323	286,439
Apr-15	595	73,711	69,568	79,215	72,310	295,399
May-15	5,259	78,694	72,340	86,297	77,174	319,764
Jun-15	11,987	72,449	65,742	82,998	69,570	302,746
Jul-15	28,595	75,379	71,394	79,026	74,041	328,435
Aug-15	28,409	92,299	84,057	84,363	87,211	376,339
Sep-15	26,809	84,143	84,776	84,289	85,123	365,140
Oct-15	19,775	82,683	83,390	63,475	84,825	334,148
Nov-15	6,438	62,615	61,477	50,888	58,004	239,422
Dec-15	9,835	72,886	72,465	73,431	47,996	276,613
Jan-16	4,034	38,348	36,826	37,168	19,768	138,160
Feb-16	11,732	93,120	99,206	96,284	99,188	399,530
Mar-16	12,533	126,123	134,329	140,226	139,536	552,747
Apr-16	13,262	128,473	130,223	135,499	133,197	540,654
May-16	27,002	125,098	124,280	138,033	130,513	544,926
Jun-16	30,405	117,877	111,309	133,036	122,798	515,425
Jul-16	37,492	108,334	102,335	115,028	110,577	473,766
Aug-16	48,323	130,666	123,827	136,746	131,957	571,519
Sep-16	49,555	122,625	115,898	129,454	127,606	545,138
Oct-16	51,170	111,105	110,038	116,087	116,489	504,889
Nov-2016	47,039	72,761	92,941	100,083	99,508	412,332
Dec-2016	48,946	102,329	97,321	79,274	102,097	429,967
Jan-2017	47,286	50,748	27,307	97,947	104,689	327,977
Feb-2017	45,366	96,629	94,065	88,239	98,411	422,710
Mar-2017	53,021	87,160	33,983	121,578	126,722	422,464
Apr-2017	49,833	110,418	116,486	122,506	120,727	519,970
May-2017	54,375	128,362	128,310	118,908	134,173	564,128
Jun-2017	60,671	131,745	124,019	146,333	138,056	600,824
Jul-2017	58,442	137,750	130,136	146,134	139,778	612,240
Aug-2017	60,322	136,739	128,716	145,280	139,257	610,314
Sep-2017	58,388	146,759	135,632	157,248	150,762	648,789
Oct-2017	48,644	148,071	149,899	159,639	157,788	664,041
Nov-2017	39,868	123,026	134,197	141,153	140,478	578,722
Dec-2017	38,801	138,219	137,672	142,389	141,303	598,384
Jan-2018	45,373	140,341	139,290	141,045	142,167	608,216
Feb-2018	30,490	110,604	109,467	111,922	111,629	474,112
Mar-2018	72,863	110,844	106,466	112,417	111,189	513,779
Apr-2018	71,726	120,656	114,768	125,831	116,442	549,423
May-2018	44,674	132,258	125,752	144,129	117,108	563,921
Jun-2018	95,030	115,819	110,643	124,698	115,955	562,145
Jul-2018	101,000	119,381	112,276	127,372	118,550	578,579
Aug-2018	101,506	118,221	112,287	125,491	117,047	574,552
Sep-2018	87,151	118,143	111,706	124,499	115,705	557,204
Oct-2018	94,699	107,645	101,002	110,869	107,856	522,071



**Figure 2. Reports received through each repeater (ALERT2 Only)**

A convenient mechanism to track repeater performance throughout the year is to monitor total ALERT2 reports passed by each repeater. In general, each of the primary repeaters in the District process an equivalent number of ALERT2 reports because pass/block filtering is not being used. Several months are evident where the throughput of one repeater is not consistent with the other three.

Network outages were experienced on February 22 and February 23 which decreased the reception of data at the base station from all repeaters.

The throughput at the West Creek repeater increased in June and July as the Hayman Burn stations came on-line and additional sites are converted to ALERT2.

The throughput at the West Creek repeater decreased in September.

The following tables summarize the system-wide latency of ALERT2 self-reports (Table 6 and Table 7).

**Table 6. System-Wide Latency of ALERT2 Self-Reports (seconds)**

Statistical Parameter	Value (sec)	Comments
Mean	57.32	The average time it took a report from the field to reach the base
Minimum	-2,242	The minimum time it took for a report to go from the field to the base
Maximum	35,638	The maximum time it took for a report to go from the field to the base

**Table 7. Summary of ALERT2 System-Wide Latency (seconds)**

Statistical Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	48.79	51.82	60.96	75.43	117.33	63.90	323.46	54.91	58.98	57.32		
Minimum	-34	-23	-23	-963	-23	-46	-3	-2	-1042	-2,242		
Maximum	37,677	33,597	30,677	42,277	36,100	43,300	43,280	3,702	39,518	35,638		
Station with Minimum Latency	West Creek WX	West Creek WX	West Creek WX	West Creek WX	West Creek WX	East Cherry Creek at Russellville	OneRain Weather	West Creek WX	East/ West Trailhead	East/ West Trailhead		
Station with Maximum Latency	West Creek WX	West Creek WX	West Creek WX	West Creek WX	West Creek WX	Happy Canyon at North Surrey Drive	Pine Cliff Road	Columbine Open Space	East/ West Trailhead	East/ West Trailhead		

Large positive and negative latencies were observed from the station West Creek WX. A new ALERT2 board was installed in mid May 2018 at this station which resolved the issue.

## D. Rain Sensor Timer Reporting Summary

The following analysis assumes that each legacy rain sensor has a 12-hour timer-reporting interval and each A2 rain sensor has a 1-hour timer-reporting interval. The worst performing rain sensors for the month are summarized (Table 8).

**Table 8. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)**

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
2790	2790	2340	2790	700	420	2360	1620	3070	2350		
4550	3020	2360	2240	2330	2330	2340	2360	2330	4470		
1660	1110	2230	2340	2340	4870	330	3010	6601	2360		
2330	3010	2250	2330	2850	330	2330	100260	1620	2230		
2980	1660	2270	3020	1620	940	2320	2330	1660	2240		
5940	4550	2350	5720	4870	1660	2350	4510	3010	2260		

\*- Only sensors that operate year-round (weather stations and stations in Boulder County) are included for the analysis in these months.

Sensors identified as having poor timer performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

## III. Rain Sensor Event Reporting Summary

### A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors were analyzed to quantify the District-wide statistical total monthly tip summary (Table 9). For the months of January, February, March, October, November and December only the stations that operate year-round are included in the rain event analysis. These stations include all weather stations and the stations in Boulder County.

**Table 9. District-Wide Total Tip/Count Statistical Summary**

Statistical Parameter	Value	Comments
Mean	28.12	Only the 1-mm rain sensors were included in the analysis
Median	26	Only the 1-mm rain sensors were included in the analysis
Standard deviation	12.19	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	64.7	Only the 1-mm rain sensors were included in the analysis
Mean minus two standard deviations	3.74	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	SPR at Union Ave. (1640), Cub Cr Below Blue (2270)
Maximum total count	73	Shanahan Ridge (4810)
Sensors showing <b>NO</b> rain for the month		None
Sensors greater than 3 SD (over reporting)	3	Shanahan Ridge (4810)



## B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 10).

**Table 10. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count**

Year	Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*	Ave
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13	5.04	16.45	24.19
2007	11.56	5.40	29.75	65.03	68.30	15.87	36.20	46.38	22.13	29.50	6.54	11.29	29.00
2008	4.05	7.38	12.26	20.57	54.82	26.06	16.43	90.20	37.54	19.59	2.82	9.24	25.08
2009	6.33	3.11	11.37	59.26	63.45	68.00	65.00	20.00	27.29	30.24	11.00	5.60	30.89
2010	5.97	11.90	32.54	70.57	39.63	56.04	50.23	31.01	4.18	18.31	8.30	3.31	27.67
2011	6.78	7.45	7.54	33.94	92.68	39.42	90.87	18.25	37.67	25.73	10.41	13.59	32.03
2012	4.89	13.57	2.35	30.17	38.97	19.35	73.03	11.31	48.81	22.32	2.98	4.18	22.66
2013	2.96	14.31	21.86	35.96	45.87	16.39	52.33	50.63	229.74	29.64	5.86	4.00	42.46
2014	6.88	11.86	25.91	29.30	77.30	29.16	99.73	43.59	50.96	29.26	13.36	8.11	35.45
2015	9.88	24.42	20.78	69.75	143.07	86.93	54.59	29.95	7.16	53.28	22.08	10.80	44.39
2016	4.68	9.91	32.30	52.10	49.40	40.50	24.20	31.00	8.86	7.51	8.56	8.74	23.23
2017	13.3	5.84	27.70	39.10	99.60	15.33	40.80	44.58	40.74	31.88	7.38	5.35	31.13
2018	4.70	8.34	29.1	24.53	64.17	30.76	58.05	24.18	24.36	28.12			
<b>Ave</b>	<b>6.66</b>	<b>9.95</b>	<b>20.91</b>	<b>42.37</b>	<b>65.90</b>	<b>35.20</b>	<b>56.58</b>	<b>37.54</b>	<b>43.35</b>	<b>28.19</b>	<b>8.03</b>	<b>7.74</b>	<b>28.32</b>

\*- Only sensors that operate year-round (weather stations and stations in Boulder County) are included for the analysis in these months.  
**229.74** – This represents an extreme monthly value.

## C. Sensors with a Jump of Six or More in the Sequential Count

The following sensors experienced a large jump in the sequential tip count (Table 11).

**Table 11. Sensors with a Jump of 6 or More in Sequential Count**

Sensor Description	Sensor ID	Comment
Van Bibber @ Hwy 93	330	All >6 tips were breaks in data
Slaughterhouse Gulch	1620	All >6 tips were breaks in data
SBC @ SB Road	4870	Data should have been flagged as invalid but wasn't

## D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 97 percent. A total of 5,311 incrementing reports were received and a total of 5,484 reports were expected. The total loss of incrementing reports for the month was approximately 3 percent. Those sensors with the worst event transmission performance are summarized (Table 12).

**Table 12. Monthly Summary of Sensors with the Worst Performance**

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
1700	2810	2270	2270	4470	3090	2360	940	2960	2340		
2980	1110	2230	1620	2340	2340	2340	1620	4510	4870		
4790	540	4870	1710	2330	100260	940	650	2340	2240		
4320	2330	940	2240	4270	2330	100260	4490	2330	4330		
3010	4330	100140	4270	1620	3010	2280	1640	4490	940		
3030	3020	1530	4870	100420	4040	2970	840	2360	330		

\*-Only sensors that are operational year-round (weather stations and stations in Boulder County) are included for the analysis in these months.

Sensors identified as having poor event performance in multiple months are shaded with unique colors. A developing trend can thus be identified from the color shading as the year progresses.

## IV. Unknown Device Analysis – Received Data Log

The ALERT IDs present in the audio signal received by the decoder are compared against a list of “active” device IDs that are defined within NovaStar. Those IDs received by the decoder that are not defined within NovaStar are considered to be “unknown” and may be the result of radio noise or problems with the telemetry system. The reception of “unknown” device reports for the month is summarized (Table 13).

**Table 13. Summary of Unknown IDs**

Description	Concentrator	Legacy	A2
Total number of unknown IDs (IDs without a device definition)	269	210	0
Total reports from unknown IDs	2,191	602	0
Unknown IDs with only a single received report (potential noise)	172	150	0
Total reports from all IDs – RecData Log entire month	343,918	198,651	522,071
Unknown reports as a fraction of total reports	0.64%	0.30%	0.00%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 14) are the total reports received from unknown sensor IDs for each month of the year.

**Table 14. Monthly Summary of Total Reports from Unknown IDs (Concentrator)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	1,220	1,474	1,276	1,174	721	5,707	610	1,738	442	533	2,857	6,396
2011	1,231	2,165	3,065	1,254	2,051	439	489	456	191	683	747	861
2012	692	750	1,575	977	5,469	11,016	453	683	774	2,657	3,854	5,466
2013	4,265	994	1,100	2,589	3,623	6,973	5,230	1,070	4,429	781	13,459	1,213
2014	870	4,284	2,399	2,104	25,746	1,832	3,983	268	369	448	470	1,099
2015	542	9,137	1,524	1,007	946	699	1,179	1,860	1,153	1,063	600	619
2016	323	1,241	3,085	3,586	1,268	945	1,408	2,029	1,413	753	617	879
2017	11,875	844	1,207	3,700	2,693	642	610	6,678	780	5,097	3,532	3,282
2018	788	771	1,178	936	749	484	1,349	8,946	4,199	2,191		

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 15).

**Table 15. Monthly Percent of Unknown Sensor Reports (Concentrator)**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.42%	0.56%	0.38%	0.32%	0.20%	1.61%	0.17%	0.49%	0.13%	0.16%	0.93%	1.88%
2011	0.39%	0.73%	0.90%	0.37%	0.58%	0.12%	0.12%	0.05%	0.12%	0.18%	0.22%	0.26%
2012	0.30%	0.25%	0.43%	0.26%	1.37%	2.74%	0.11%	0.18%	0.20%	0.72%	1.15%	1.62%
2013	1.40%	0.31%	0.29%	0.60%	0.37%	0.61%	0.82%	0.21%	0.96%	0.31%	5.37%	0.23%
2014	0.14%	0.94%	0.40%	0.34%	3.95%	0.34%	0.66%	0.03%	0.03%	0.07%	0.11%	0.26%
2015	0.15%	2.25%	0.34%	0.22%	0.19%	0.14%	0.26%	0.42%	0.29%	0.24%	0.15%	0.15%
2016	0.10%	0.30%	0.69%	0.82%	0.28%	0.22%	0.33%	0.50%	0.36%	0.18%	0.17%	0.22%
2017	3.29%	0.23%	0.31%	0.97%	0.58%	0.16%	0.16%	1.16%	0.21%	1.40%	0.96%	0.87%
2018	0.21%	0.23%	0.31%	0.26%	0.23%	0.13%	0.35%	2.42%	1.22%	0.64%		

Any month shaded in yellow has an excessive number of reports from unknown sensors.

A number of “unknown” sensors had multiple reports, which may indicate the existence of a transmitter that is sending information on an ID that is not currently defined within NovaStar. The unknown IDs with multiple reports including the number of reports received by each are shown (Table 16).

Unknown data transmissions from an ALERT legacy transmitter are being received containing sensor ID 2101 as seen in the table below. These transmissions are received at the base as ALERT2 data concentration packets initiating from source address 9001. The transmissions are received through the Blue Mountain and the Gold Hill repeaters.

**Table 16. Reports Received by Unknown IDs**

Concentrator		Legacy ALERT		Comment
Unknown ID	Reports	Unknown ID	Reports	
2101	1,510			Large amount of invalid data from this ID
		0,1,2	61,60,89	Legacy reports for IDs 0,1,2 only
3071	39			Newlin Gulch at Jordan Road possibly sending invalid ID
3044	30			East Cherry Creek at Russelville possibly sending invalid ID
3047	16			East Cherry Creek at Russelville possibly sending invalid ID

## V. Sensors with Invalid Reports

The sensors below (Table 17 and Table 18) have the largest number of invalid decodes as determined by the validation process defined at the District NovaStar5 base station. These invalid reports may indicate poor radio paths (bit flip/contention errors/random decode) or validation criteria that do not match the physical installation at the site.

**Table 17. Rain Sensors with the Most Invalid Reports**

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1530-Bear Cr. At Lowell	10	5	3	4	1	--	1	--	--	3		
2810-Pine Cliff Rd.	14	10	10	6	6	3	2	3	2	12		
2880-Happy Canyon	--	--	47*	--	77*	--	--	--	--	--		
3010-Wx-EPC @ 105	3	5	7	5	1	4	4	4	--	1		
3050-E/W Trailhead	7	12	3	9	--	3	4	4	7	11		
4030-Red Garden	--	3	3	--	--	7	1	--	1	--		
4330-Hansen	--	3	--	--	1	3	4	1	1	--		
4240-Sunset	1	4	2	1	1	--	--	7	--	--		
4790-Wx-Button Rock	--	--	--	1	2	--	1	2	--	--		

\*-Happy Canyon (2880) All invalid data points are because this station went through maintenance to upgrade to ALERT2.

**Table 18. Level Sensors with the Most Invalid Reports**

Sensor ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
413-Kelly Dam	--	--	5	--	12	3	6	9	4	1		
403-Montview Park	1171**	766**	411**	--	--	--	--	--	1	--		
213-Leyden Confluence	--	--	3	--	--	--	2	8	--	--		
723-WTG above Conf Pond	--	--	3	--	2	--	--	3	--	--		
1523-Marston Lake North	9	7	10	8	4	2	1	1	2	2		
1649-SPR at 19 <sup>th</sup> Street	--	--	1	4	--	--	1	1	1	1		
2223-Evergreen Lake	--	--	2	2	--	3	2	--	1	1		
2273-Cub Cr below Blue	--	--	3	--	--	2	3	3	2	--		
2803-Columbine Open Space	--	--	--	1	3	--	--	13	41	12		
2813-Pine Cliff Road	15	13	9	10	3	--	5	5	4	10		
3013-EPC@Hwy 105	18	20	8	10	9	13	4	13	9	17		
4383-Eldorado Springs	--	4	1	--	1	3	--	1	--	--		

\*\* -Montview Park (403) All data values are marked as questionable data values because they exceeded an allowable upper boundary. Kate Malers developed a new rating for this site which needs to be incorporated into both NovaStar5 and Contrail in 2018.

## VI. Rainfall Alarms and Intensity Analysis

The following rainfall rate alarms from the Urban Drainage and Flood Control District NovaStar 5.0 Web Server were identified this month.

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Point Numid	Point Name	Trigger Name	Alarm Time
4820	Doudy Draw Precipitation-BO	Boulder County 10 minute rainfall	10/12/2018 8:02
4820	Doudy Draw Precipitation-BO	Boulder County 1 hour rainfall	10/12/2018 8:11
4820	Doudy Draw Precipitation-BO	Boulder County 10 minute rainfall	10/12/2018 8:13
4870	SBC @ South Boulder Road Precipitation-BO	Boulder County 1 hour rainfall	10/18/2018 8:34
4870	SBC @ South Boulder Road Precipitation-BO	Boulder County 10 minute rainfall	10/18/2018 8:34
4870	SBC @ South Boulder Road Precipitation-BO	Boulder County 2 hour rainfall	10/18/2018 8:34

# General System Analysis

**Database Name** P:\A207-UDFCD-Data-Analysis\2018\10-2018\Oct2018.mdb

Summarize

<b>First Date in Database</b>	10/1/18 12:00 AM	<b>Total Days</b>	31.0
<b>Last Date in Database</b>	11/1/18 12:00 AM	<b>Total Hours</b>	744.0

**Total Records Analyzed** 1,064,640

Records by Group	Legacy	%	Concentrator	%	ALERT	%
Wind Data	61,604	31%	128,840	37%	145,649	28%
Temperature	33,567	17%	60,867	18%	82,627	16%
Relative Humidity	32,527	16%	53,498	16%	63,330	12%
Barometric Pressure	15,851	8%	25,956	8%	4,241	1%
Precipitation	11,307	6%	14,020	4%	48,000	9%
Water Level	10,100	5%	11,211	3%	52,628	10%
Battery Voltage	9,782	5%	22,187	6%	73,975	14%
Fuel Moisture	5,658	3%	5,706	2%	0	0%
Fuel Temperature	5,640	3%	5,686	2%	0	0%
Solar Radiation	5,043	3%	5,124	1%	14,916	3%
Soil Moisture	2,908	1%	2,925	1%	0	0%
Repeater Status Report	2,260	1%	1,844	1%	0	0%
ET-Hourly	721	0%	728	0%	0	0%
Unknown	602	0%	2,191	1%	0	0%
Repeater Pass List	542	0%	67	0%	0	0%
12Hr Status Report	256	0%	263	0%	2,549	0%
Water Temp	118	0%	121	0%	0	0%
Not Used	74	0%	82	0%	0	0%
Handar 585 ALARM Status	59	0%	59	0%	0	0%
ET-Daily	31	0%	31	0%	0	0%
Solar Power	1	0%	1	0%	0	0%
Hayman Battery	0	0%	2,312	1%	0	0%
GPS Lock	0	0%	199	0%	34,156	7%
	0	0%	0	0%	0	0%
<b>Total</b>	<b>198,651</b>	<b>100%</b>	<b>343,918</b>	<b>100%</b>	<b>522,071</b>	<b>100%</b>

Traffic Loading Summary	Legacy	Concentrator	ALERT
Alert Reports	198,651	343,918	522,071
Average Daily Traffic	6,408	11,094	16,841
Average Hourly Traffic	267	462	702
Median Hourly Traffic	268	462	715
Peak Hourly Traffic	525	790	961
2nd Max	496	660	954
3rd Max	432	655	925
4th Max	428	651	922
5th Max	428	648	911

	hour beginning	hour beginning	hour beginning
	Oct 7, 10:00 PM	Oct 7, 10:00 PM	Oct 7, 10:00 PM
	Oct 6, 2:00 AM	Oct 6, 2:00 AM	Oct 11, 2:00 PM
	Oct 6, 1:00 AM	Oct 7, 9:00 PM	Oct 11, 3:00 PM
	Oct 6, 3:00 AM	Oct 4, 1:00 PM	Oct 2, 3:00 PM

# Rain Timer Performance

Analyze Rain Sensors

Rain Sensors	Description	Rcv	Timer	Exp	Performance
2350	Idledale	4	11:59	62	6%
4470	Little Narrows	4	11:59	62	6%
2360	Indian Hills	5	14:57	62	8%
2230	Bear Cr below Cub	6	11:58	62	10%
2240	Cold Sprg Glch conf	6	11:58	62	10%
2260	Brook Forest	6	11:58	62	10%
2280	Kinney Peak	6	11:58	62	10%
2270	Cub Cr below Blue	7	11:58	62	11%
2340	El Rancho	8	16:45	62	13%
840	Fire Station 12	12	12:00	62	19%
2310	Genesee Village	13	11:56	62	21%
940	Aurora Regional Pond	14	11:57	62	23%
2250	Rosedale	14	11:57	62	23%
850	Flying J	16	12:00	62	26%
950	Piney at Liverpool	16	11:57	62	26%
100100	A2-Blackstone Precip	16	12:00	62	26%
100160	A2-Sand Creek at Colfax Precip	202	1:00	744	27%
1710	Shop Creek	18	14:00	62	29%
730	No Name @ Quincy	22	11:58	62	35%
760	Mission Viejo Park	22	11:57	62	35%
1480	Third Creek at DIA	22	11:59	62	35%
100110	A2-ETG @ Hampden Precip	22	12:00	62	35%
870	A2-Murphy Creek GC	274	1:00	744	37%
720	Confluence Pond	23	11:19	62	37%
830	Side Creek Park	23	12:00	62	37%
1900	Niver Detention	28	13:00	62	45%
300	Van Bibber Park	29	11:58	62	47%
1300	Hidden Lake	29	11:58	62	47%
120	West Woods	30	11:58	62	48%
1310	LDC at 64th	370	1:00	744	50%
100	A2-Carr Street	371	1:00	744	50%
210	Leyden Confluence	31	11:58	62	50%
320	Sports Complex	31	11:58	62	50%
100140	A2-Upper Sellers Gulch Precip	446	1:00	744	60%
2330	Morrison	38	18:09	62	61%
4330	Hansen Rain	39	13:04	62	63%
2920	West Cherry Head-Douglas Cnty	40	12:21	62	65%
150	Nott Creek	41	12:20	62	66%
2960	Indian Creek	41	12:45	62	66%
100150	A2-Sellers Gulch at Haystack Precip	496	1:00	744	67%
310	Guy Hill Ranch	42	11:36	62	68%
2800	Columbine Open Space	511	1:00	744	69%
2890	Spruce Mt - Douglas	43	12:20	62	69%
2900	Russelville Gulch-Douglas	43	12:19	62	69%
2910	East Cherry Cr-Douglas	43	12:00	62	69%
2950	DC Public Works	43	12:38	62	69%
2820	Haskins Gulch Conf	44	12:41	62	71%
2940	Willow Creek - DougCnty	44	12:00	62	71%
3040	CC @ Russelville Road Precip	528	1:00	744	71%
2810	Pine Cliff Road	535	1:00	744	72%
2840	Sulphur Gulch	45	12:56	62	73%
2850	Cherry Cr bl Bayou Glch	45	12:37	62	73%
3050	East/West Trailhead	546	1:00	744	73%
2860	CC at Stroh Rd	46	12:34	62	74%

3080	Tallman Gulch	46	12:37	62	74%
2880	Happy Canyon at N Surrey Dr	554	1:00	744	74%
3090	A2-Highland Heritage Park	560	1:00	744	75%
100320	A2-Weir Gulch - Precip	561	1:00	744	75%
330	Van Bibber @ Hwy 93	47	12:33	62	76%
1620	Slaughterhouse Glch	47	11:58	62	76%
5940	Log Jumper	47	15:34	62	76%
2870	Cottonwood (Apache)	48	12:00	62	77%
3010	WX-EPC at Hwy 105	48	15:23	62	77%
3060	Fire Sta 47	580	1:00	744	78%
100490	Coal Creek at Twin Spruce Rd - Precipitation	584	1:00	744	78%
100500	Upper Coal Creek at Camp Eden Rd - Precipitation	584	1:00	744	78%
100260	Wx-A2-Trumbull (Hayman) - Precip	611	1:00	744	82%
1660	SPR at Henderson	51	13:21	62	82%
5720	Four Mile Creek	51	14:20	62	82%
4270	Cannon Mountain	53	12:30	62	85%
2320	Choke Cherry Resvr	55	12:30	62	89%
2750	Wx-Castle Rock	55	13:16	62	89%
4490	Apple Valley	55	13:03	62	89%
110	Ralston Reservoir	56	11:58	62	90%
630	Temple Pond at DTC	56	13:05	62	90%
1800	Sand Creek Park	56	12:43	62	90%
2980	Dakan Rd	56	13:06	62	90%
140	Wx-Blue Mountain	57	12:00	62	92%
410	Kelly Dam	57	12:45	62	92%
1360	Denver Zoo	57	12:28	62	92%
4040	Martin Gulch	57	12:47	62	92%
4510	Pinewood Springs	57	12:14	62	92%
220	Upper Leyden	58	12:15	62	94%
2930	Wx-Spring Valley Rd-DougCnty	58	12:12	62	94%
4030	Red Garden	58	12:27	62	94%
4070	Bear Peak	58	12:27	62	94%
4340	Riverside	58	12:13	62	94%
4790	Wx-Button Rock	58	12:00	62	94%
420	Expo Park	59	11:57	62	95%
540	Parker/Mississippi	59	12:11	62	95%
650	Iliff Pond	59	12:29	62	95%
1060	Heritage Square	59	11:57	62	95%
1350	Chatfield COE	59	12:00	62	95%
1370	West Metro FS13	59	12:13	62	95%
1400	Upper Sloan Det.	59	12:13	62	95%
1530	Bear Creek @ Lowell	59	12:27	62	95%
2990	Wx-Tomah Rd-DougCnty	59	12:14	62	95%
4090	Magnolia	59	12:13	62	95%
4290	Red Hill	59	12:13	62	95%
4350	Conifer Hill	59	12:13	62	95%
5740	Trail Creek	59	12:29	62	95%
100290	A2-PlumCr at Sedalia - Precip	719	1:00	744	97%
440	Fire Station #7	60	11:57	62	97%
510	Virginia Court	60	11:42	62	97%
610	Harvard @ Jackson	60	12:11	62	97%
710	Horseshoe Park Drop	60	12:12	62	97%
900	Wx-Aurora Reservoir	60	12:13	62	97%
1010	Denver West	60	11:42	62	97%
1320	SPR at 3rd Ave	60	12:12	62	97%
1440	Wx-Elbert	60	12:00	62	97%
1500	Powers Park	60	11:58	62	97%
1520	Wx-Marston Lake North	60	12:00	62	97%
1550	Lakewood CC	60	11:57	62	97%

1700	Cherry Cr @ Champa	60	12:11	62	97%
2370	Red Rocks Park	60	11:42	62	97%
4020	Rio Grande	60	11:57	62	97%
4100	Filter Plant	60	12:15	62	97%
4170	Pine Brook	60	12:12	62	97%
4180	Gold Lake	60	12:04	62	97%
4190	Slaughterhouse	60	11:57	62	97%
4260	Taylor Mountain	60	12:13	62	97%
4300	Big Elk Park	60	12:12	62	97%
4360	Justice Center	60	11:57	62	97%
5730	West Creek	60	12:13	62	97%
5810	Stump Bump	60	12:15	62	97%
5880	Hackett Mountain	60	12:15	62	97%
6601	Wx-A2-Magnolia WX-Precip	180	4:00	186	97%
100270	Wx-A2-WestCreek (Hayman) - Precip	723	1:00	744	97%
3020	Wx-West Creek WX	731	1:00	744	98%
400	Montview Park	61	12:00	62	98%
430	Utah Park	61	11:57	62	98%
530	Fire Station #19	61	11:57	62	98%
620	Quincy/Highline	61	11:57	62	98%
640	Goldsmith @ Eastman	61	11:44	62	98%
700	Toll Gate @ 6th	61	11:45	62	98%
750	Wx-Quincy Reservoir	61	12:14	62	98%
800	Sable Ditch @ 18th	61	11:57	62	98%
1040	Lena @ U.S. Hwy 6	61	11:42	62	98%
1050	Jeffco Fairgrounds	61	11:57	62	98%
1100	Louisville Rec Ctr	61	11:59	62	98%
1420	Wx-A2-Diamond Hill	61	12:00	62	98%
1570	Wx-Brighton Ditch	61	11:46	62	98%
2210	Wx-Hiwan G.C.	61	12:00	62	98%
3030	WX-Bingham Lake Park	61	12:07	62	98%
4050	Walker Ranch	61	12:07	62	98%
4080	Twin Sisters	61	11:57	62	98%
4110	Betasso	61	11:57	62	98%
4130	Swiss Peaks	61	11:57	62	98%
4140	Logan Mill	61	11:58	62	98%
4150	Gold Hill	61	11:58	62	98%
4240	Sunset	61	11:58	62	98%
4310	Johnny Park	61	11:57	62	98%
4520	Eagle Ridge	61	11:58	62	98%
4530	Winiger Ridge	61	11:58	62	98%
4570	St. Antons	61	12:04	62	98%
4710	Wx-Ward C-1	61	12:00	62	98%
4750	Wx-Louisville Lake	61	12:00	62	98%
4770	Wx-Cal-Wood Ranch	61	12:00	62	98%
4810	Shanahan Ridge	61	11:57	62	98%
4820	Doudy Draw	61	11:43	62	98%
4830	SBC @ San Souci	61	11:57	62	98%
4860	Fairview Peak	61	12:00	62	98%
5860	Cedar Mountain	61	12:00	62	98%
100200	Wx-A2-OneRain Weather - Precipitation	61	12:00	62	98%
100300	A2-CoalCreek at McCaslin - Precip	735	1:00	744	99%
100410	A2-Brantner Gulch - Precip	735	1:00	744	99%
1000	A2-Maple Grove Resv.	736	1:00	744	99%
1340	Sanderson at Xavier	736	1:00	744	99%
4850	Porphyry Mtn	736	1:00	744	99%
100230	A2-Havana Pond Precip	736	1:00	744	99%
100240	A2-Westerly Cr Dam Precip	736	1:00	744	99%
100420	A2-Thorncreek - Precip	737	1:00	744	99%



500	Havana Park	62	11:43	62	100%
520	Jewell Detention	62	11:42	62	100%
810	Granby Ditch @ 6th	62	11:57	62	100%
970	Pump Sta 3	62	11:47	62	100%
1110	Gunbarrel	62	11:42	62	100%
1460	Wx-Urban Farm	62	11:46	62	100%
1720	Cherry Cr @ Steele	62	11:57	62	100%
1920	Wx-Brighton	62	11:46	62	100%
4010	Crescent	62	11:43	62	100%
4060	Lakeshore	62	11:57	62	100%
4160	Sunshine	62	11:42	62	100%
4200	Lazy Acres	62	11:44	62	100%
4220	Fling's	62	11:29	62	100%
4550	Boulder Jail	62	11:42	62	100%
200	Leyden Reservoir	63	11:42	62	100%
600	Harvard Gulch Park	63	11:42	62	100%
820	ETG @ Buckley	63	11:48	62	100%
1030	NREL/S. Table Mtn.	63	11:45	62	100%
1200	Broomfield 3207	63	11:44	62	100%
1600	Englewood Dam	63	11:43	62	100%
2710	Wx-Highlands Ranch WTP	63	11:30	62	100%
2730	Wx-Salisbury Park	63	11:29	62	100%
4230	Golden Age	63	11:43	62	100%
4250	Geer Canyon	63	11:41	62	100%
4320	Lee Hill Rain 2012	63	11:42	62	100%
4730	Wx-Sugarloaf	63	11:38	62	100%
4880	Whispering Pines	63	11:28	62	100%
1640	SPR at Union Ave.	64	11:12	62	100%
4840	SBC@S Boulder Ditch	64	11:27	62	100%
4870	SBC @ SB Road	98	6:43	62	100%
2970	Rampart Range Rd-Satellite	179		179	100%
5900	Horse Creek-Satellite	1169		1169	100%

# Rain Event Performance

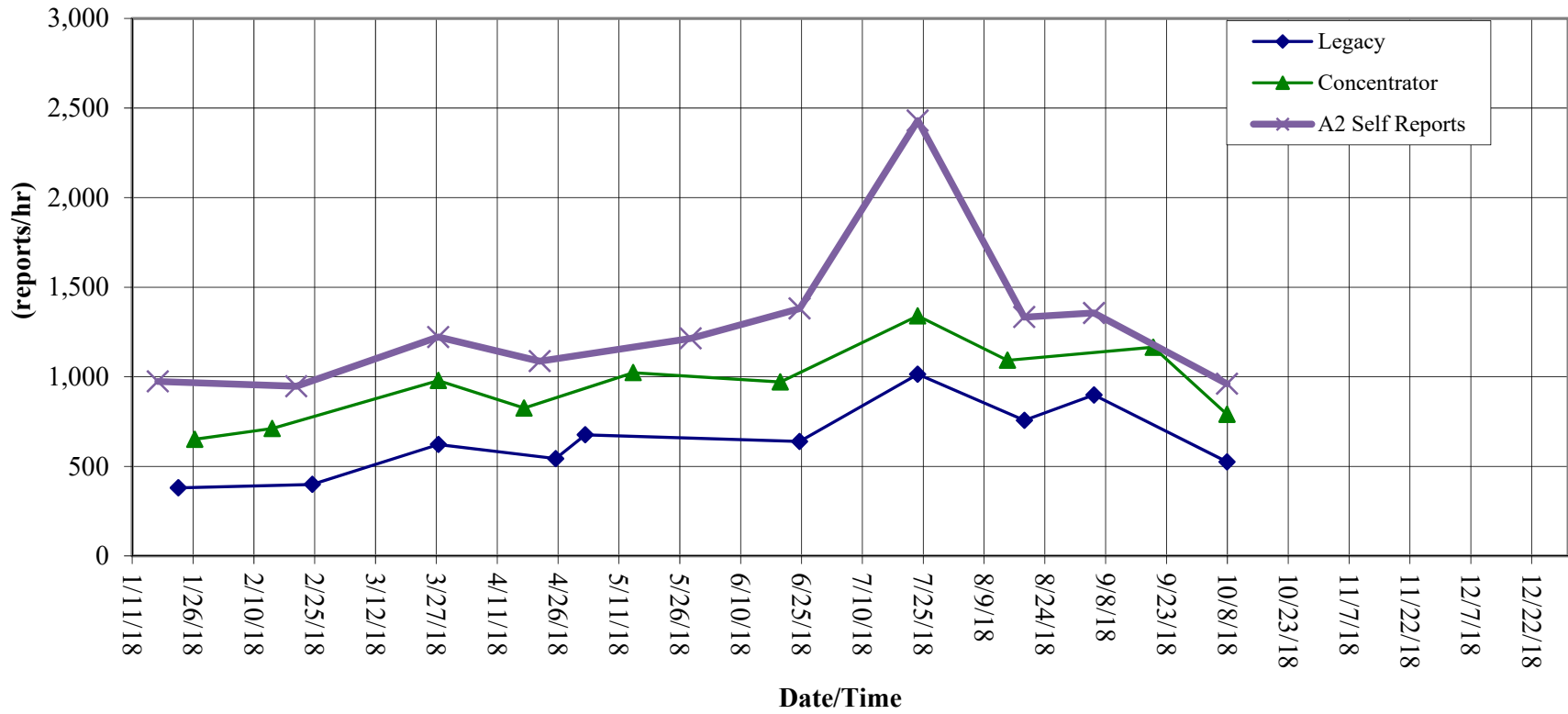
Description	Reports Received	Reports Received	Analyze Rain Sensors												
	96.59%	5,311	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket	
	Systemwide Avg	5,484													
	Data Loss	3.15%													
El Rancho	2340	36%	1	2	0	0	0	1	0	4	11	7	0	0.0393701	
SBC @ SB Road	4870	63%	10	1	4	0	0	0	31	15	24	9	2	0.0393701 Mean 28.12	
Cold Sprg Glch conf	2240	67%	1	1	0	0	0	0	0	2	3	1	0	0.0393701 Median 26	
Hansen Rain	4330	76%	31	4	4	0	0	0	0	39	51	12	0	0.0393701 St. Dev 12.19	
Aurora Regional Pond	940	80%	13	2	1	0	0	0	0	16	20	4	0	0.0393701 Mean plus 3 SD 64.7	
Van Bibber @ Hwy 93	330	81%	12	0	0	1	0	0	1	13	16	3	0	0.0393701 Mean Minus 2 SD 3.74	
SPR at Henderson	1660	81%	10	3	0	0	0	0	0	13	16	3	0	0.0393701 Min 1	
Horse Creek-Satellite	5900	83%	19	0	0	0	1	0	0	20	24	4	0	0.0393701 Max 73	
Wx-A2-Trumbull (Hayman) - Precip	100260	83%	17	2	1	0	0	0	0	20	24	4	0	0.0393701	
Slaughterhouse Glch	1620	85%	15	1	1	0	0	1	17	20	3	0	0	0.0393701	
Wx-Button Rock	4790	86%	33	2	2	0	0	0	0	37	43	6	0	0.0393701	
DC Public Works	2950	87%	11	2	0	0	0	0	11	13	15	2	0	0.0393701	
Dakan Rd	2980	87%	34	4	1	0	0	0	0	39	45	6	0	0.0393701	
Walker Ranch	4050	88%	24	4	0	0	0	0	0	28	32	4	0	0.0393701	
Cannon Mountain	4270	88%	32	3	1	0	0	0	0	36	41	5	0	0.0393701	
Red Garden	4030	88%	33	5	0	0	0	0	0	38	43	5	0	0.0393701	
WX-EPC at Hwy 105	3010	89%	21	3	0	0	0	0	0	24	27	3	0	0.0393701	
Morrison	2330	89%	29	4	0	0	0	0	0	33	37	4	0	0.0393701	
Four Mile Creek	5720	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701	
Eagle Ridge	4520	90%	33	4	0	0	0	0	0	37	41	4	0	0.0393701	
Sports Complex	320	90%	17	2	0	0	0	0	17	19	21	2	0	0.0393701	
Wx-Highlands Ranch WTP	2710	92%	21	2	0	0	0	0	0	23	25	2	0	0.0393701	
Denver Zoo	1360	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701	
Toll Gate @ 6th	700	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701	
Lakewood CC	1550	93%	23	2	0	0	0	0	0	25	27	2	0	0.0393701	
Temple Pond at DTC	630	93%	36	3	0	0	0	0	0	39	42	3	0	0.0393701	
Hidden Lake	1300	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701	
Wx-Brighton Ditch	1570	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701	
Wx-Elbert	1440	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701	
Shop Creek	1710	93%	13	1	0	0	0	0	13	14	15	1	0	0.0393701	
WX-Bingham Lake Park	3030	94%	27	2	0	0	0	0	0	29	31	2	0	0.0393701	
Cherry Cr @ Champa	1700	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701	
Lakeshore	4060	94%	29	2	0	0	0	0	0	31	33	2	0	0.0393701	
Big Elk Park	4300	94%	29	2	0	0	0	0	0	31	33	2	0	0.0393701	
Cherry Cr bl Bayou Glch	2850	94%	15	1	0	0	0	0	0	16	17	1	0	0.0393701	
Crescent	4010	94%	30	2	0	0	0	0	0	32	34	2	0	0.0393701	
Conifer Hill	4350	94%	30	2	0	0	0	0	0	32	34	2	0	0.0393701	
St. Antons	4570	94%	30	2	0	0	0	0	0	32	34	2	0	0.0393701	
Pinewood Springs	4510	94%	47	3	0	0	0	0	0	50	53	3	0	0.0393701	
Confluence Pond	720	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701	
Fire Station 12	840	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701	
Genesee Village	2310	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701	
Choke Cherry Resvr	2320	94%	33	0	1	0	0	0	0	34	36	2	0	0.0393701	
Sulphur Gulch	2840	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701	
Trail Creek	5740	94%	16	1	0	0	0	0	0	17	18	1	0	0.0393701	
Justice Center	4360	95%	55	3	0	0	0	0	0	58	61	3	0	0.0393701	
Sand Creek Park	1800	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701	
Flying J	850	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701	
Piney at Liverpool	950	96%	21	1	0	0	0	0	0	22	23	1	1	0.0393701	
Cherry Cr @ Steele	1720	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701	
Wx-Castle Rock	2750	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701	
Wx-Spring Valley Rd-DougCnty	2930	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701	
Rampart Range Rd-Satellite	2970	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701	
Lazy Acres	4200	96%	47	2	0	0	0	0	0	49	51	2	0	0.0393701	
Ralston Reservoir	110	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701	
Leyden Confluence	210	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701	
Fire Sta 47	3060	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701	

West Woods	120	96%	25	1	0	0	0	0	0	26	27	1	0	0.0393701
Wx-Blue Mountain	140	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
Leyden Reservoir	200	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
Harvard Gulch Park	600	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
Quincy/Highline	620	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
Louisville Rec Ctr	1100	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
Denver West	1010	97%	30	1	0	0	0	0	0	31	32	1	0	0.0393701
Virginia Court	510	97%	31	1	0	0	0	0	0	32	33	1	0	0.0393701
Rio Grande	4020	97%	31	1	0	0	0	0	0	32	33	1	0	0.0393701
Fire Station #7	440	97%	32	1	0	0	0	0	0	33	34	1	0	0.0393701
Heritage Square	1060	97%	33	1	0	0	0	0	0	34	35	1	0	0.0393701
Gold Lake	4180	97%	34	1	0	0	0	0	0	35	36	1	0	0.0393701
Slaughterhouse	4190	97%	34	1	0	0	0	0	0	35	36	1	0	0.0393701
Lena @ U.S. Hwy 6	1040	97%	35	1	0	0	0	0	0	36	37	1	0	0.0393701
Martin Gulch	4040	98%	39	1	0	0	0	0	0	40	41	1	0	0.0393701
Golden Age	4230	98%	39	1	0	0	0	0	0	40	41	1	0	0.0393701
Wx-Ward C-1	4710	98%	40	1	0	0	0	0	0	41	42	1	0	0.0393701
Johnny Park	4310	98%	41	1	0	0	0	0	0	42	43	1	0	0.0393701
Twin Sisters	4080	98%	42	1	0	0	0	0	0	43	44	1	0	0.0393701
Wx-Sugarloaf	4730	98%	45	1	0	0	0	0	0	46	47	1	0	0.0393701
Lee Hill Rain 2012	4320	98%	46	1	0	0	0	0	0	47	48	1	0	0.0393701
Taylor Mountain	4260	98%	47	1	0	0	0	0	0	48	49	1	0	0.0393701
Riverside	4340	98%	47	1	0	0	0	0	0	48	49	1	0	0.0393701
Magnolia	4090	98%	48	1	0	0	0	0	0	49	50	1	0	0.0393701
Red Hill	4290	98%	54	1	0	0	0	0	0	55	56	1	0	0.0393701
A2-Brantner Gulch - Precip	100410	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
A2-Thorncreek - Precip	100420	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
A2-Carr Street	100	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
Nott Creek	150	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701
Upper Leyden	220	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Van Bibber Park	300	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Guy Hill Ranch	310	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
Montview Park	400	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Kelly Dam	410	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
Expo Park	420	100%	47	0	0	0	0	0	0	47	47	0	0	0.0393701
Utah Park	430	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
Havana Park	500	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
Jewell Detention	520	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
Fire Station #19	530	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701
Parker/Mississippi	540	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Harvard @ Jackson	610	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
Goldsmith @ Eastman	640	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Iliff Pond	650	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701
Horseshoe Park Drop	710	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
No Name @ Quincy	730	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
Wx-Quincy Reservoir	750	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
Mission Viejo Park	760	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Sable Ditch @ 18th	800	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
Granby Ditch @ 6th	810	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
ETG @ Buckley	820	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
Side Creek Park	830	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
A2-Murphy Creek GC	870	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
Pump Sta 3	970	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
A2-Maple Grove Resv.	1000	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
NREL/S. Table Mtn.	1030	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
Jeffco Fairgrounds	1050	100%	32	0	0	0	0	0	0	32	32	0	0	0.0393701
Gunbarrel	1110	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701
Broomfield 3207	1200	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
LDC at 64th	1310	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
SPR at 3rd Ave	1320	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Sanderson at Xavier	1340	100%	29	0	0	0	0	0	0	29	29	0	1	0.0393701
Chatfield COE	1350	100%	28	0	0	0	0	0	0	28	28	0	0	0.0393701

West Metro FS13	1370	100%	27	0	0	0	0	0	0	27	27	0	0	0.0393701
Upper Sloan Det.	1400	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
Wx-A2-Diamond Hill	1420	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Wx-Urban Farm	1460	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Third Creek at DIA	1480	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
Powers Park	1500	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Wx-Marston Lake North	1520	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Bear Creek @ Lowell	1530	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
Englewood Dam	1600	100%	30	0	0	0	0	0	0	30	30	0	0	0.0393701
SPR at Union Ave.	1640	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Niver Detention	1900	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
Wx-Brighton	1920	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
Wx-Hiwan G.C.	2210	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
Rosedale	2250	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
Brook Forest	2260	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Cub Cr below Blue	2270	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Red Rocks Park	2370	100%	36	0	0	0	0	0	0	36	36	0	0	0.0393701
Wx-Salisbury Park	2730	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Columbine Open Space	2800	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Pine Cliff Road	2810	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Haskins Gulch Conf	2820	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
CC at Stroh Rd	2860	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
Cottonwood (Apache)	2870	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
Happy Canyon at N Surrey Dr	2880	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Spruce Mt - Douglas	2890	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
Russelville Gulch-Douglas	2900	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
East Cherry Cr-Douglas	2910	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
West Cherry Head-Douglas Cnty	2920	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
Willow Creek - DougCnty	2940	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
Indian Creek	2960	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
Wx-Tomah Rd-DougCnty	2990	100%	40	0	0	0	0	0	0	40	40	0	0	0.0393701
Wx-West Creek WX	3020	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
CC @ Russelville Road Precip	3040	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
East/West Trailhead	3050	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
Tallman Gulch	3080	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
A2-Highland Heritage Park	3090	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Bear Peak	4070	100%	32	0	0	0	0	0	0	32	32	0	0	0.0393701
Filter Plant	4100	100%	50	0	0	0	0	0	0	50	50	0	0	0.0393701
Betasso	4110	100%	58	0	0	0	0	0	0	58	58	0	0	0.0393701
Swiss Peaks	4130	100%	38	0	0	0	0	0	0	38	38	0	0	0.0393701
Logan Mill	4140	100%	31	0	0	0	0	0	0	31	31	0	0	0.0393701
Gold Hill	4150	100%	40	0	0	0	0	0	0	40	40	0	0	0.0393701
Sunshine	4160	100%	46	0	0	0	0	0	0	46	46	0	0	0.0393701
Pine Brook	4170	100%	52	0	0	0	0	0	0	52	52	0	0	0.0393701
Fling's	4220	100%	44	0	0	0	0	0	0	44	44	0	0	0.0393701
Sunset	4240	100%	37	0	0	0	0	0	0	37	37	0	0	0.0393701
Geer Canyon	4250	100%	59	0	0	0	0	0	0	59	59	0	0	0.0393701
Apple Valley	4490	100%	38	0	0	0	0	0	0	38	38	0	0	0.0393701
Winiger Ridge	4530	100%	41	0	0	0	0	0	0	41	41	0	0	0.0393701
Boulder Jail	4550	100%	38	0	0	0	0	0	0	38	38	0	0	0.0393701
Wx-Louisville Lake	4750	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
Wx-Cal-Wood Ranch	4770	100%	31	0	0	0	0	0	0	31	31	0	0	0.0393701
Shanahan Ridge	4810	100%	73	0	0	0	0	0	0	73	73	0	0	0.0393701
Doudy Draw	4820	100%	51	0	0	0	0	0	0	51	51	0	0	0.0393701
SBC @ San Souci	4830	100%	46	0	0	0	0	0	0	46	46	0	0	0.0393701
SBC@S Boulder Ditch	4840	100%	45	0	0	0	0	0	0	45	45	0	0	0.0393701
Whispering Pines	4880	100%	45	0	0	0	0	0	0	45	45	0	0	0.0393701
West Creek	5730	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
Stump Bump	5810	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
Cedar Mountain	5860	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
Hackett Mountain	5880	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
Log Jumper	5940	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701

A2-Blackstone Precip	100100	100%	23	0	0	0	0	0	0	23	23	0	1	0.0393701
A2-ETG @ Hampden Precip	100110	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
A2-Upper Sellers Gulch Precip	100140	100%	11	0	0	0	0	0	0	11	11	0	1	0.0393701
A2-Sellers Gulch at Haystack Precip	100150	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
A2-Sand Creek at Colfax Precip	100160	100%	20	0	0	0	0	0	0	20	20	0	0	0.0393701
A2-Havana Pond Precip	100230	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
A2-Westerly Cr Dam Precip	100240	100%	19	0	0	0	0	0	0	19	19	0	0	0.0393701
Wx-A2-WestCreek (Hayman) - Precip	100270	100%	24	0	0	0	0	0	0	24	24	0	0	0.0393701
A2-PlumCr at Sedalia - Precip	100290	100%	34	0	0	0	0	0	0	34	34	0	0	0.0393701
A2-CoalCreek at McCaslin - Precip	100300	100%	39	0	0	0	0	0	0	39	39	0	1	0.0393701
A2-Weir Gulch - Precip	100320	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
Coal Creek at Twin Spruce Rd - Precipitation	100490	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
Upper Coal Creek at Camp Eden Rd - Precipitation	100500	100%	32	0	0	0	0	0	0	32	32	0	0	0.0393701
Wx-Aurora Reservoir	900	100%	22	0	0	0	0	0	0	22	22	0	0	0.0393701
	Total Tips		5163	129	16	1	1	1	1					
Wx-A2-OneRain Weather - Precipitation	100200	93%	119	7	0	1	0	0	0	127	137	10	0	0.01
Wx-A2-Magnolia WX-Precip	6601	96%	148	2	0	0	0	1	0	151	158	7	1	0.01
Porphyry Mtn	4850	97%	73	2	0	0	0	0	0	75	77	2	0	0.01
Fairview Peak	4860	99%	96	1	0	0	0	0	0	97	98	1	0	0.01

## 2018 Monthly Peak Hour ALERT Radio Traffic Summary



## Sunburst Plot

Inner Ring: Displays the ratio of ALERT2 data reports between the Diamond Hill and Westy decoders

Second Ring: Displays the ratio of ALERT2 data reports between the five repeaters

Third Ring: Displays the event performance for each ALERT2 site

Outer Ring: Displays the timer performance for each ALERT2 site

Many stations reported low timer performance because they were powered off during the month of October.

