

Memo

Date: June 20, 2013
To: Kevin Stewart
From: Markus Ritsch
Subject: May 2013 ALERT Data Analysis

I. ALERT Data Source

Raw ALERT data records extracted from the Urban Drainage and Flood Control District's NovaStar 5.0 base station were analyzed for the period May 1 through May 31, 2013.

II. General System Analysis Summary

In 2013 the District will upgrade the telemetry backbone from legacy ALERT (A1) to the new A2 protocol. As the season progresses, the A1 feed from outlying repeaters to the District base station at Diamond Hill will terminate and all data will be received as A2. The following table quantifies the data reception throughout the conversion of the telemetry system as the season progresses. As of January 29, 2013, the West Creek repeater in Douglas County processes both incoming data on A1 and A2 but passes on only A2 format messages to Diamond Hill.

Table 1. Reception of A1/A2 Data at Diamond Hill

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Legacy	321,136	218,368	264,984	243,044	318,423							
Concentrator	304,067	319,089	379,891	381,523	571,616							
ALERT2	--	--	16,450	47,415	88,786							
TOTAL	625,203	537,457	661,325	671,982	978,825	0	0	0	0	0	0	0
Conc+A2	--	--	396,341	428,938	660,402							

In 2013, WET will analyze only the concentrator and A2 data each month going forward since only the concentrator and A2 data received at Diamond Hill represents a complete dataset.

The total number of reports received by the NS5 base station in the received data log has significantly increased between April and May. This is due to a couple of reasons. In May, the NS5 base station software was moved to a new VMServer. During the move, data collection was interrupted as the serial data feed via a USB port was only partially functional for a period of several days in late May (28, 29, 30). The feed was changed to a serial/IP device and the intervening data was manually backfilled causing duplicate reports in the received log.

Also, the A2 direct reports are not pass-blocked at the repeaters and we now have up to four reports being received from a single transmission as it is coming in through multiple repeaters.

The peak hour of radio traffic occurred on May 8 between 5:00 PM and 6:00 PM where 1,995 reports were received. The distribution of messages for this hour is: 1,023 legacy ALERT, 1,844 data concentrator and 151 A2 self-report.

The highest reporting sensor during this hour was Aurora Regional Pond (ID 943) which had 79 entries in the received data log. These 79 entries included 27 legacy ALERT reports and 52 A2 data concentrator reports. This site reports as legacy ALERT on 169.500 being received at Blue Mt repeater and is then re-broadcast as legacy ALERT on 171.875 and A2 concentrator on 170.300. If only Blue Mt heard this site, there would be a one-to-one relationship between legacy reports and A2 concentrator reports but we have twice as many A2 concentrator reports. It looks like this site is received by two repeaters that are not pass blocked.

In 2012 the ratio of A2 concentrator reports to legacy ALERT reports was one-to-one. In 2013 we are receiving twice as many A2 concentrator reports. We do expect to see an increase in A2 reports in 2013 because the West Creek repeater no longer forwards legacy data...only A2. Receiving twice as many A2 reports seems high.

A. Performance of New A2 Sites

Currently there are only a handful of remote sites operating on the new A2 protocol. The “**event**” performance of these sites will be tracked throughout the 2013 flood season.

Table 2. Event Performance of New A2 Sites

Description	ID	Install Date	Apr	May	Jun	Jul	Aug	Sep	Oct
Heritage Regional Park	3090	03/14/2013	100%	93%					
ETG @ Hampden	100110	05/01/2013	--	100%					
Blackstone	100100	05/03/2013	--	100%					
Newlin Gulch	3070	05/24/2013	--	--					
Carr Street	100	05/31/2013	--	--					
Maple Grove	1000	05/20/2013	--	--					

B. Specific Issues Identified this Month

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

Table 3. Rain Sensors with Poor Performance Characteristics

Sensor ID	Description	Timer	Event	Comments
4470	Little Narrows	84%	64%	
5900	Horse Creek-Satellite	71%	67%	Station was down in the early part of the month.
2980	Dakan Road	92%	73%	
2790	Wx-W. Cherry Creek	56%	74%	Station was down in the early part of the month due to power surge. Site is running but needs new PT and RHAT.
840	Fire Station 12	50%	82%	
3070	Newlin Gulch	45%	100%	Station was placed into operation as an A2 station in mid-May so missing data in the early part of the month.
3020	Wx-West Creek	66%	100%	
2800	Columbine Open Space	47%	95%	Station was down and has been fixed.
1700	Cherry Creek at Champa	55%	100%	
100100	A2-Blackstone	65%	100%	Station was down May 8 – 15.
730	No Name at Quincy – this site seems to be under reporting rain relative to neighboring stations for the second month in a row.			
1000	As of May 20 the Maple Grove station seems to be using a 12 minute timer report interval.			

C. Continuous Operation of Base Receiver/Decoder

The data feeds to the NS5 base station were **NOT** in continuous operation for the entire month. During the move of NS5 to the new VMServer, the serial feed to the USB port was not functional. Data reception was marginal from May 28 through May 30. A new serial/IP feed was established on May 30.

III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer-reporting interval. The worst performing rain sensors for the month are summarized (Table 4).

Table 4. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470	4470	2790	1200	3070							
3070	4550	4550	840	2800							
1660	4870	2710	800	840							
2790	2790	4870	4330	1700							
4870	4490	4270	2360	2790							
2320	4510	4190	620	100100							

*- 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.

IV. 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 5). 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 5. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	45.87	Only the 1-mm rain sensors were included in the analysis
Median	44	Only the 1-mm rain sensors were included in the analysis
Standard deviation	15.63	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	92.76	Only the 1-mm rain sensors were included in the analysis
Minimum total count	3	No Name @ Quincy (730) – second month in a row that this sensor is the lowest reporting
Maximum total count	106	Utah Park (430) – irrigation influence

B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 6).

Table 6. 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								

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

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

Several sensors experienced a large jump in the sequential tip count (Table 7).

Table 7. Sensors with a Jump of 6 or More in Sequential Count

Sensor Description	Sensor ID	Comment
Little Narrows	4470	Several large jumps in sequential count observed on May 7
Wx-Button Rock	4790	Two random decodes with bit errors

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 95 percent. A total of 8,101 incrementing reports were received and a total of 8,487 reports were expected. The total loss of incrementing reports for the month was approximately 5 percent. Those sensors with the worst event transmission performance are summarized (Table 8).

Table 8. Monthly Summary of Sensors with the Most Missed Tips

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470	4510	4270	1200	4470							
2330	2930	4490	840	5900							
2980	4470	4790	4330	2980							
1660	2980	4510	4100	2790							
--	2730	4320	4270	840							
--	4790	4870	2980	4060							

*-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.

V. Heavy Radio Traffic Analysis

Periods exceeding 1,000 messages per hour are analyzed independently in an attempt to quantify data loss rates from rain sensors using their sequential tip count series.

A. The Heaviest Hourly Traffic Periods This Month

The hourly periods of highest radio traffic this month are shown (Table 9). Each hour exceeding 1,000 reports was analyzed to quantify the number of missing rain reports for that hour.

Table 9. Periods of Heavy Radio Traffic

Day	Hour	Expected	Received	Total Load	Loss
8	17	308	301	1,995	0.02%
9	15	164	163	1,877	0.01%
29	9	220	217	1,757	0.01%
8	16	236	235	1,713	0.00%
24	13	100	100	1,645	0.00%

VI. 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 10).

Table 10. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	1,931
Total reports from unknown IDs	3,623
Unknown IDs with only a single received report (potential noise)	1,276
Total reports from all IDs – RecData Log entire month	978,825
Unknown reports as a fraction of total reports	0.37%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 11) are the total reports received from unknown sensor IDs for each month of the year.

Table 11. Monthly Summary of Total Reports from Unknown IDs

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							

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 12).

Table 12. Monthly Percent of Unknown Sensor Reports

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%							

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 13).

Table 13. Reports Received by Unknown IDs

Unknown ID	Reports	Comment
5104	51	Received the entire month as legacy and concentrator
2215	30	Received the entire month as legacy and concentrator – Hiwan??
1486	24	Received on 5/29 as legacy and concentrator – DIA at Third Creek??
8191	22	Received only from 5/1 to 5/13 as legacy and concentrator
1487	21	Received on 5/29 as legacy and concentrator – DIA at Third Creek??
910	20	Received only from 5/1 to 5/13 as legacy and concentrator
2239	19	Received the entire month as legacy and concentrator
718	18	Received the entire month as legacy and concentrator
1482	18	Received on 5/29 as legacy and concentrator- DIA at Third Creek??
2222	15	Received the entire month as legacy and concentrator – Evergreen Lake??
1481	14	Received on 5/29 as legacy and concentrator – DIA at Third Creek??

VII. Sensors with Invalid Reports

The following sensors had a large number of invalid reports (bit flip/contention errors/random decode):

Sensor ID	Description	Bad Reports	Comments
2210	Wx-Hiwan GC	17	Bad legacy decodes for the entire month.
3090	A2-Highland Heritage	16	Field maintenance on 5/8 and 5/9.
4770	Wx-Cal-Wood Ranch	12	Bad legacy decodes for the entire month.
2230	Bear Cr below Cub	12	Bad legacy decodes for the entire month.
4260	Taylor Mt	11	Bad legacy decodes for the entire month.
750	Wx-Quincy Res	10	Bad legacy decodes for the entire month.

VIII. 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.

Urban Drainage and Flood Control District
ALERT Web Server

2860	Cherry Creek at Stroh Precipitation-DG	Douglas County 10 minute rainfall	05/09/2013 13:36:40
800	Sable Ditch @ Colfax Precipitation-AD	Plains 10 minute rainfall	05/15/2013 16:01:17
2850	CC blw Bayou Gulch Precipitation-DG	Douglas County 10 minute rainfall	05/09/2013 14:45:00

General System Analysis

Database Name

C:\A207\05-2013\Novastar_extract_2013May.mdb

First Date in Database

5/1/13 12:00 AM

Total Days

31.0

Last Date in Database

5/31/13 11:59 PM

Total Hours

744.0

Total Records Analyzed

660,401

Records by Group

Wind Data	208,904	32%
Temperature	100,722	15%
Relative Humidity	93,655	14%
Water Level	61,885	9%
Battery Voltage	42,235	6%
Barometric Pressure	41,717	6%
Precipitation	33,172	5%
Solar Radiation	19,698	3%
Fuel Temperature	9,131	1%
Fuel Moisture	9,016	1%
Peak Wind	8,615	1%
Dew Point Temperature	8,610	1%
Wind Chill	8,609	1%
Soil Moisture	5,323	1%
Unknown	3,623	1%
Repeater Status Report	2,512	0%
Flasher Status	1,452	0%
12Hr Status Report	884	0%
Hayman Battery	366	0%
Handar 585 ALARM Status	125	0%
Repeater Pass List	104	0%
Dewpoint Temperature	26	0%
ALERT/A2 Testing	7	0%
Solar Power	5	0%
Repeater ON Count	2	0%
Evapotranspiration	1	0%
Hayman Stream	1	0%
Repeater Battery Check	1	0%
Total	660,401	

Records by Major Group

Meteorologic Sensors	255,792	39%
Water Level Sensors	61,885	9%
Rain Sensors	33,172	5%
Soil and Fuel Sensors	23,470	4%
Sensor Status Transmissions	3,630	1%
Total	377,949	

Traffic Loading Summary

Alert Reports	660,401	
Average Daily Traffic	21,303	
Average Hourly Traffic	888	
Median Hourly Traffic	876	hour beginning
Peak Hourly Traffic	1,995	May 8, 5:00 PM
2nd Max	1,877	May 9, 3:00 PM
3rd Max	1,757	May 29, 9:00 AM
4th Max	1,713	May 8, 4:00 PM
5th Max	1,645	May 24, 1:00 PM

Rain Timer Performance

Analyze Rain Sensors

Rain Sensors	Description	Rcv	Timer	Exp	Performance
3070	Newlin Gulch	28	5:45	62	45%
2800	Columbine Open Space	29	11:24	62	47%
840	Fire Station 12	31	22:21	62	50%
1700	Cherry Cr @ Champa	34	12:00	62	55%
2790	Wx-W. Cherry Creek	35	14:18	62	56%
100100	A2-Blackstone Precip	40	13:27	62	65%
3020	Wx-West Creek WX	41	12:22	62	66%
4870	SBC @ SB Road	45	15:46	62	73%
1660	SPR at Henderson	47	13:12	62	76%
4770	Wx-Cal-Wood Ranch	47	13:03	62	76%
2990	Wx-Tomah Rd-DougCnty	48	13:27	62	77%
5720	Four Mile Creek	48	12:47	62	77%
3030	WX-Bingham Lake Park	49	13:50	62	79%
1200	Broomfield 3207	50	12:48	62	81%
2850	Cherry Cr bl Bayou Glch	50	14:17	62	81%
3060	Fire Sta 47	50	15:08	62	81%
2930	Wx-Spring Valley Rd-DougCnty	51	14:27	62	82%
3090	A2-Highland Heritage Park-A2	51	14:10	62	82%
2750	Wx-Castle Rock	52	13:06	62	84%
3080	Tallman Gulch	52	13:31	62	84%
4470	Little Narrows	52	13:03	62	84%
2870	Cottonwood (Apache)	53	14:05	62	85%
4790	Wx-Button Rock	53	12:16	62	85%
4850	Porphory Mtn	53	12:37	62	85%
4520	Eagle Ridge	54	12:45	62	87%
1710	Shop Creek	55	12:46	62	89%
4330	Hansen Rain	55	12:13	62	89%
2240	Cold Sprg Glch conf	56	12:13	62	90%
4570	St. Antons	56	12:33	62	90%
2270	Cub Cr below Blue	57	11:57	62	92%
2900	Russelville Gulch-Douglas	57	12:46	62	92%
2940	Willow Creek - DougCnty	57	12:43	62	92%
2980	Dakan Rd	57	12:29	62	92%
4010	Cresent	57	12:30	62	92%
4710	Wx-Ward C-1	57	12:00	62	92%
100110	A2-ETG @ Hampden Precip	57	11:40	62	92%
430	Utah Park	58	12:17	62	94%
920	Wx-Aurora Town Hall	58	12:16	62	94%
2320	Choke Cherry Resvr	58	12:15	62	94%
2910	East Cherry Cr-Douglas	58	12:28	62	94%
4220	Fling's	58	11:40	62	94%
4510	Pinewood Springs	58	12:30	62	94%
4550	Boulder Jail	58	12:12	62	94%
4880	Whispering Pines	58	12:14	62	94%
5730	West Creek	58	12:28	62	94%
1360	Denver Zoo	59	12:14	62	95%
1440	Wx-Elbert	59	12:13	62	95%
1520	Wx-Marston Lake North	59	12:14	62	95%
2210	Wx-Hiwan G.C.	59	12:00	62	95%
2880	Happy Canyon at N Surrey Dr	59	12:28	62	95%
2890	Spruce Mt - Douglas	59	12:28	62	95%
2920	West Cherry Head-Douglas Cnty	59	12:28	62	95%
2950	DC Public Works	59	12:00	62	95%
4060	Lakeshore	59	12:13	62	95%

4300	Big Elk Park	59	11:57	62	95%
4730	Wx-Sugarloaf	59	12:00	62	95%
310	Guy Hill Ranch	60	11:57	62	97%
700	Toll Gate @ 6th	60	12:30	62	97%
940	Sampson Gulch	60	11:57	62	97%
1350	Chatfield COE	60	12:29	62	97%
2360	Indian Hills	60	11:58	62	97%
2730	Wx-Salisbury Park	60	12:13	62	97%
2810	Pine Cliff Road	60	12:13	62	97%
2820	Haskins Gulch Conf	60	12:00	62	97%
2960	Indian Creek	60	12:28	62	97%
3010	EPC at Hwy 105	60	12:14	62	97%
3040	CC @ Prairie Canyon Ranch	60	12:27	62	97%
3050	East/West Trailhead	60	12:13	62	97%
4230	Golden Age	60	11:58	62	97%
4260	Taylor Mountain	60	11:11	62	97%
4270	Cannon Mountain	60	11:58	62	97%
4530	Winiger Ridge	60	11:57	62	97%
4750	Wx-Louisville Lake	60	12:13	62	97%
4820	Doudy Draw	60	12:12	62	97%
4830	SBC @ San Souci	60	11:28	62	97%
4860	Fairview Peak	60	12:00	62	97%
5740	Trail Creek	60	12:14	62	97%
5810	Stump Bump	60	12:00	62	97%
540	Parker/Mississippi	61	11:43	62	98%
870	Murphy Creek GC	61	11:46	62	98%
900	Wx-Aurora Reservoir	61	12:00	62	98%
970	Pump Sta 3	61	11:45	62	98%
1420	Wx-Diamond Hill	61	12:14	62	98%
1620	Slaughterhouse Glch	61	11:43	62	98%
1920	Wx-Brighton	61	12:13	62	98%
2330	Morrison	61	11:58	62	98%
4170	Pine Brook	61	11:59	62	98%
4200	Lazy Acres	61	11:43	62	98%
4240	Sunset	61	11:42	62	98%
4290	Red Hill	61	11:16	62	98%
5860	Cedar Mountain	61	11:53	62	98%
5880	Hackett Mountain	61	12:00	62	98%
140	Wx-Blue Mountain	62	11:46	62	100%
440	Fire Station #7	62	11:44	62	100%
850	Flying J	62	11:44	62	100%
860	Sand Cr at Colfax	62	11:45	62	100%
1340	Sanderson at Xavier	62	12:00	62	100%
1500	Powers Park	62	11:24	62	100%
1570	Wx-Brighton Ditch	62	11:46	62	100%
2230	Bear Cr below Cub	62	11:16	62	100%
2310	Genesee Village	62	11:28	62	100%
2860	CC at Stroh Rd	62	11:18	62	100%
4080	Twin Sisters	62	11:29	62	100%
4090	Magnolia	62	11:28	62	100%
4110	Betasso	62	11:30	62	100%
4180	Gold Lake	62	11:27	62	100%
4310	Johnny Park	62	11:29	62	100%
4340	Riverside	62	11:43	62	100%
4810	Shanahan Ridge	62	11:44	62	100%
150	Nott Creek	63	11:30	62	102%
220	Upper Leyden	63	11:46	62	102%
410	Kelly Dam	63	11:44	62	102%
520	Jewell Detention	63	11:30	62	102%

630	Temple Pond at DTC	63	11:24	62	102%
1060	Heritage Square	63	11:30	62	102%
1300	Hidden Lake	63	11:43	62	102%
1460	Wx-Urban Farm	63	11:46	62	102%
1550	Lakewood CC	63	11:17	62	102%
2260	Brook Forest	63	11:28	62	102%
4030	Red Garden	63	11:32	62	102%
4070	Bear Peak	63	11:01	62	102%
4130	Swiss Peaks	63	11:29	62	102%
4150	Gold Hill	63	11:37	62	102%
4190	Slaughterhouse	63	11:14	62	102%
4250	Geer Canyon	63	11:30	62	102%
4360	Justice Center	63	11:01	62	102%
110	Ralston Reservoir	64	11:18	62	103%
210	Leyden Confluence	64	11:29	62	103%
400	Montview Park	64	11:30	62	103%
650	Iliff Pond	64	11:05	62	103%
810	Granby Ditch @ 6th	64	11:15	62	103%
1010	Denver West	64	11:17	62	103%
1100	Louisville Rec Ctr	64	11:08	62	103%
1110	Gunbarrel	64	11:31	62	103%
1400	Upper Sloan Det.	64	10:49	62	103%
1480	Third Creek at DIA	64	11:18	62	103%
1720	Cherry Cr @ Steele	64	11:29	62	103%
1800	Sand Creek Park	64	11:29	62	103%
1900	Niver Detention	64	11:31	62	103%
2280	Kinney Peak	64	11:06	62	103%
2340	El Rancho	64	11:17	62	103%
2350	Idledale	64	11:30	62	103%
2370	Red Rocks Park	64	11:04	62	103%
4040	Martin Gulch	64	11:29	62	103%
4100	Filter Plant	64	11:31	62	103%
4490	Apple Valley	64	11:20	62	103%
300	Van Bibber Park	65	11:17	62	105%
320	Sports Complex	65	11:16	62	105%
420	Expo Park	65	11:28	62	105%
510	Virginia Court	65	11:15	62	105%
710	Horseshoe Park Drop	65	11:07	62	105%
750	Wx-Quincy Reservoir	65	11:00	62	105%
800	Sable Ditch @ 18th	65	11:02	62	105%
820	ETG @ Buckley	65	11:03	62	105%
1050	Jeffco Fairgrounds	65	11:04	62	105%
1310	LDC at 64th	65	11:17	62	105%
1530	Bear Creek @ Lowell	65	11:05	62	105%
1640	SPR at Union Ave.	65	11:06	62	105%
1810	Sand Creek at mouth	65	11:03	62	105%
2250	Rosedale	65	10:52	62	105%
4050	Walker Ranch	65	11:03	62	105%
4140	Logan Mill	65	11:14	62	105%
200	Leyden Reservoir	66	11:04	62	106%
330	Van Bibber @ Hwy 93	66	11:06	62	106%
500	Havana Park	66	11:11	62	106%
530	Fire Station #19	66	10:54	62	106%
600	Harvard Gulch Park	66	11:03	62	106%
610	Harvard @ Jackson	66	11:05	62	106%
640	Goldsmith @ Eastman	66	10:53	62	106%
730	No Name @ Quincy	66	11:00	62	106%
760	Mission Viejo Park	66	10:54	62	106%
830	Side Creek Park	66	10:55	62	106%

950	Piney at Liverpool	66	10:57	62	106%
1030	NREL/S. Table Mtn.	66	10:53	62	106%
1040	Lena @ U.S. Hwy 6	66	11:05	62	106%
1370	West Metro FS13	66	11:09	62	106%
1600	Englewood Dam	66	10:53	62	106%
4020	Rio Grande	66	10:52	62	106%
4160	Sunshine	66	11:13	62	106%
4840	SBC@S Boulder Ditch	66	11:04	62	106%
120	West Woods	67	10:52	62	108%
620	Quincy/Highline	67	10:55	62	108%
720	Confluence Pond	67	10:57	62	108%
1320	SPR at 3rd Ave	67	10:52	62	108%
2840	Sulphur Gulch	67	10:44	62	108%
4320	Lee Hill Rain 2012	76	9:29	62	123%
1000	Maple Grove Resv.	1361		62	2195%
5900	Horse Creek-Satellite	44		62	71%

Rain Event Performance		Reports Received	8,101	Analyze Rain Sensors											
	Systemwide Avg	Total Tips	8,487												
	95.45%	Data Loss	4.55%												
Description	Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket	
Little Narrows	4470	64%	39	7	0	0	0	1	2	47	73	26	0	0.0393701	
Horse Creek-Satellite	5900	67%	2	2	0	0	0	0	0	4	6	2	0	0.0393701	
Dakan Rd	2980	73%	22	9	0	1	0	0	0	32	44	12	0	0.0393701	
Wx-W. Cherry Creek	2790	74%	14	0	3	0	0	0	0	17	23	6	0	0.0393701	
Fire Station 12	840	82%	34	1	0	1	1	0	0	37	45	8	0	0.0393701	
Lakeshore	4060	83%	51	4	1	2	0	0	0	58	70	12	0	0.0393701	
Wx-Cal-Wood Ranch	4770	84%	44	7	0	1	0	0	1	52	62	10	0	0.0393701	
SPR at Henderson	1660	84%	26	6	0	0	0	0	0	32	38	6	0	0.0393701	
Wx-Aurora Town Hall	920	85%	51	4	3	0	0	0	0	58	68	10	0	0.0393701	
Crescent	4010	87%	53	4	1	1	0	0	0	59	68	9	0	0.0393701	
Cub Cr below Blue	2270	87%	42	5	1	0	0	0	0	48	55	7	0	0.0393701	
Choke Cherry Resvr	2320	88%	38	2	2	0	0	0	0	42	48	6	0	0.0393701	
Hansen Rain	4330	88%	38	4	1	0	0	0	0	43	49	6	0	0.0393701	
Four Mile Creek	5720	88%	39	4	1	0	0	0	0	44	50	6	0	0.0393701	
Cold Sprg Glch conf	2240	89%	36	3	1	0	0	0	0	40	45	5	0	0.0393701	
SBC @ SB Road	4870	89%	36	3	1	0	0	0	0	40	45	5	0	0.0393701	
St. Antons	4570	89%	67	7	1	0	0	0	0	75	84	9	0	0.0393701	
Wx-Ward C-1	4710	89%	45	4	1	0	0	0	0	50	56	6	0	0.0393701	
Riverside	4340	90%	40	3	1	0	0	0	0	44	49	5	0	0.0393701	
Maple Grove Resv.	1000	90%	41	3	1	0	0	0	1	45	50	5	1	0.0393701	
Morrison	2330	90%	35	2	1	0	0	0	0	38	42	4	0	0.0393701	
Eagle Ridge	4520	90%	34	4	0	0	0	0	0	38	42	4	0	0.0393701	
Utah Park	430	91%	92	1	1	1	1	0	1	96	106	10	0	0.0393701	
Pinewood Springs	4510	91%	43	5	0	0	0	0	0	48	53	5	0	0.0393701	
Guy Hill Ranch	310	91%	27	3	0	0	0	0	0	30	33	3	0	0.0393701	
Bear Cr below Cub	2230	91%	37	4	0	0	0	0	0	41	45	4	0	0.0393701	
Gold Lake	4180	91%	68	7	0	0	0	0	0	75	82	7	0	0.0393701	
Cherry Cr bl Bayou Glch	2850	92%	30	3	0	0	0	0	0	33	36	3	0	0.0393701	
Indian Creek	2960	92%	41	4	0	0	0	0	0	45	49	4	0	0.0393701	
Wx-Button Rock	4790	92%	43	2	1	0	0	0	2	46	50	4	0	0.0393701	
West Metro FS13	1370	92%	33	3	0	0	0	0	0	36	39	3	0	0.0393701	
CC at Stroh Rd	2860	92%	33	3	0	0	0	0	0	36	39	3	0	0.0393701	
Twin Sisters	4080	93%	60	3	1	0	0	0	0	64	69	5	0	0.0393701	
Doudy Draw	4820	93%	36	3	0	0	0	0	0	39	42	3	0	0.0393701	
A2-Highland Heritage Park-A2	3090	93%	38	1	1	0	0	0	1	40	43	3	0	0.0393701	
Genesee Village	2310	93%	51	2	1	0	0	0	0	54	58	4	0	0.0393701	
Chatfield COE	1350	93%	39	1	1	0	0	0	0	41	44	3	0	0.0393701	
SBC @ San Souci	4830	93%	39	1	1	0	0	0	0	41	44	3	0	0.0393701	
Montview Park	400	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701	
Parker/Mississippi	540	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701	
Temple Pond at DTC	630	93%	79	4	1	0	0	0	0	84	90	6	0	0.0393701	
Fling's	4220	94%	68	3	1	0	0	0	0	72	77	5	0	0.0393701	
Whispering Pines	4880	94%	68	3	1	0	0	0	0	72	77	5	0	0.0393701	
Spruce Mt - Douglas	2890	94%	29	2	0	0	0	0	0	31	33	2	0	0.0393701	
Big Elk Park	4300	94%	58	4	0	0	0	0	0	62	66	4	0	0.0393701	
Johnny Park	4310	94%	45	3	0	0	0	0	0	48	51	3	0	0.0393701	
Shanahan Ridge	4810	94%	46	3	0	0	0	0	0	49	52	3	0	0.0393701	
West Creek	5730	94%	47	3	0	0	0	0	0	50	53	3	0	0.0393701	
Martin Gulch	4040	94%	63	4	0	0	0	0	0	67	71	4	0	0.0393701	
Slaughterhouse	4190	94%	64	4	0	0	0	0	0	68	72	4	0	0.0393701	
Sanderson at Xavier	1340	95%	49	3	0	0	0	0	0	52	55	3	0	0.0393701	
Broomfield 3207	1200	95%	33	2	0	0	0	0	0	35	37	2	0	0.0393701	
Tallman Gulch	3080	95%	34	2	0	0	0	0	0	36	38	2	0	0.0393701	
Happy Canyon at N Surrey Dr	2880	95%	54	1	1	0	0	0	0	56	59	3	0	0.0393701	
Slaughterhouse Glch	1620	95%	36	2	0	0	0	0	0	38	40	2	0	0.0393701	
Columbine Open Space	2800	95%	37	2	0	0	0	0	1	39	41	2	0	0.0393701	
Taylor Mountain	4260	95%	58	1	1	0	0	0	0	60	63	3	0	0.0393701	
East/West Trailhead	3050	95%	59	1	1	0	0	0	0	61	64	3	0	0.0393701	
Cannon Mountain	4270	95%	59	1	1	0	0	0	0	61	64	3	0	0.0393701	
Fire Sta 47	3060	95%	39	2	0	0	0	0	0	41	43	2	0	0.0393701	
Wx-Elbert	1440	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701	
Indian Hills	2360	95%	40	2	0	0	0	0	0	42	44	2	0	0.0393701	
Red Rocks Park	2370	95%	40	2	0	0	0	0	0	42	44	2	0	0.0393701	
Apple Valley	4490	95%	40	2	0	0	0	0	0	42	44	2	0	0.0393701	
Cherry Cr @ Steele	1720	96%	42	2	0	0	0	0	0	44	46	2	0	0.0393701	
Boulder Jail	4550	96%	42	2	0	0	0	0	0	44	46	2	0	0.0393701	
Iliff Pond	650	96%	43	2	0	0	0	0	0	45	47	2	0	0.0393701	
Justice Center	4360	96%	44	2	0	0	0	0	1	46	48	2	0	0.0393701	
Ralston Reservoir	110	96%	22	1	0	0	0	0	0	23	24	1	0	0.0393701	
Shop Creek	1710	96%	22	1	0	0	0	0	0	23	24	1	0	0.0393701	
Wx-Highlands Ranch WTP	2710	96%	44	2	0	0	0	0	0	46	48	2	0	0.0393701	
Wx-Tomah Rd-DougCnty	2990	96%	44	2	0	0	0	0	0	46	48	2	0	0.0393701	
Cedar Mountain	5860	96%	44	2	0	0	0	0	0	46	48	2	0	0.0393701	
Virginia Court	510	96%	50	2	0	0	0	0	0	52	54	2	0	0.0393701	
Kinney Peak	2280	96%	50	2	0	0	0	0	0	52	54	2	0	0.0393701	

Lazy Acres	4200	96%	51	2	0	0	0	0	0	0	53	55	2	1	0.0393701
Winiger Ridge	4530	96%	78	1	1	0	0	0	0	0	80	83	3	0	0.0393701
Toil Gate @ 6th	700	96%	53	2	0	0	0	0	0	0	55	57	2	0	0.0393701
NREL/S. Table Mtn.	1030	97%	28	1	0	0	0	0	0	0	29	30	1	0	0.0393701
Gold Hill	4150	97%	84	3	0	0	0	0	0	0	87	90	3	0	0.0393701
Wx-Sugarloaf	4730	97%	56	2	0	0	0	0	0	0	58	60	2	0	0.0393701
Wx-Brighton	1920	97%	29	1	0	0	0	0	0	0	30	31	1	0	0.0393701
Horseshoe Park Drop	710	97%	31	1	0	0	0	0	0	0	32	33	1	0	0.0393701
Louisville Rec Ctr	1100	97%	31	1	0	0	0	0	0	0	32	33	1	0	0.0393701
Idledale	2350	97%	32	1	0	0	0	0	0	0	33	34	1	0	0.0393701
Swiss Peaks	4130	97%	69	0	1	0	0	0	0	0	70	72	2	0	0.0393701
East Cherry Cr-Douglas	2910	97%	35	1	0	0	0	0	0	0	36	37	1	0	0.0393701
West Cherry Head-Douglas Cnty	2920	97%	35	1	0	0	0	0	0	0	36	37	1	0	0.0393701
DC Public Works	2950	97%	35	1	0	0	0	0	0	0	36	37	1	0	0.0393701
Gunbarrel	1110	97%	36	1	0	0	0	0	0	0	37	38	1	0	0.0393701
Geer Canyon	4250	97%	36	1	0	0	0	0	0	0	37	38	1	0	0.0393701
Van Bibber @ Hwy 93	330	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Upper Sloan Det.	1400	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Sand Creek Park	1800	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
El Rancho	2340	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Pine Cliff Road	2810	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Sulphur Gulch	2840	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393701
Sampson Gulch	940	97%	37	1	0	0	0	0	0	0	38	39	1	0	0.0393699
Russelville Gulch-Douglas	2900	98%	38	1	0	0	0	0	0	0	39	40	1	0	0.0393701
Wx-Blue Mountain	140	98%	39	1	0	0	0	0	0	0	40	41	1	0	0.0393701
Fire Station #7	440	98%	39	1	0	0	0	0	0	0	40	41	1	0	0.0393701
WX-Bingham Lake Park	3030	98%	39	1	0	0	0	0	0	0	40	41	1	0	0.0393701
Sand Cr at Colfax	860	98%	40	1	0	0	0	0	0	0	41	42	1	0	0.0393701
Bear Creek @ Lowell	1530	98%	40	1	0	0	0	0	0	0	41	42	1	0	0.0393701
West Woods	120	98%	42	1	0	0	0	0	0	0	43	44	1	0	0.0393701
Red Garden	4030	98%	42	1	0	0	0	0	0	0	43	44	1	0	0.0393701
Red Hill	4290	98%	43	1	0	0	0	0	0	0	44	45	1	0	0.0393701
Expo Park	420	98%	45	1	0	0	0	0	0	0	46	47	1	0	0.0393701
Golden Age	4230	98%	46	1	0	0	0	0	0	0	47	48	1	0	0.0393701
Granby Ditch @ 6th	810	98%	48	1	0	0	0	0	0	0	49	50	1	0	0.0393701
Fire Station #19	530	98%	49	1	0	0	0	0	0	0	50	51	1	0	0.0393701
Rosedale	2250	98%	50	1	0	0	0	0	0	0	51	52	1	0	0.0393701
Wx-Hiwan G.C.	2210	98%	53	1	0	0	0	0	0	1	54	55	1	0	0.0393701
Powers Park	1500	98%	56	1	0	0	0	0	0	0	57	58	1	0	0.0393701
Sable Ditch @ 18th	800	98%	57	1	0	0	0	0	0	0	58	59	1	0	0.0393701
Flying J	850	98%	57	1	0	0	0	0	0	0	58	59	1	0	0.0393701
Lee Hill Rain 2012	4320	98%	60	1	0	0	0	0	0	1	61	62	1	0	0.0393701
Nott Creek	150	98%	63	1	0	0	0	0	0	0	64	65	1	0	0.0393701
Magnolia	4090	98%	63	1	0	0	0	0	0	0	64	65	1	0	0.0393701
Brook Forest	2260	98%	64	1	0	0	0	0	0	0	65	66	1	0	0.0393701
Cherry Cr @ Champa	1700	100%	24	0	0	0	0	0	0	1	24	24	0	0	0.0393701
Wx-West Creek WX	3020	100%	23	0	0	0	0	0	0	1	23	23	0	0	0.0393701
A2-ETG @ Hampden Precip	100110	100%	26	0	0	0	0	0	0	1	26	26	0	0	0.0393699
Leyden Reservoir	200	100%	42	0	0	0	0	0	0	0	42	42	0	0	0.0393701
Leyden Confluence	210	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Upper Leyden	220	100%	52	0	0	0	0	0	0	0	52	52	0	0	0.0393701
Van Bibber Park	300	100%	51	0	0	0	0	0	0	0	51	51	0	0	0.0393701
Sports Complex	320	100%	47	0	0	0	0	0	0	0	47	47	0	0	0.0393701
Kelly Dam	410	100%	42	0	0	0	0	0	0	0	42	42	0	0	0.0393701
Havana Park	500	100%	4	0	0	0	0	0	0	0	4	4	0	0	0.0393701
Jewell Detention	520	100%	44	0	0	0	0	0	0	0	44	44	0	0	0.0393701
Harvard Gulch Park	600	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Harvard @ Jackson	610	100%	45	0	0	0	0	0	0	0	45	45	0	0	0.0393701
Quincy/Highline	620	100%	46	0	0	0	0	0	0	0	46	46	0	0	0.0393701
Goldsmith @ Eastman	640	100%	49	0	0	0	0	0	0	0	49	49	0	0	0.0393701
Confluence Pond	720	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
No Name @ Quincy	730	100%	3	0	0	0	0	0	0	0	3	3	0	0	0.0393701
Wx-Quincy Reservoir	750	100%	6	0	0	0	0	0	0	0	6	6	0	0	0.0393701
Mission Viejo Park	760	100%	26	0	0	0	0	0	0	0	26	26	0	0	0.0393701
ETG @ Buckley	820	100%	41	0	0	0	0	0	0	0	41	41	0	0	0.0393701
Side Creek Park	830	100%	34	0	0	0	0	0	0	0	34	34	0	0	0.0393701
Murphy Creek GC	870	100%	40	0	0	0	0	0	0	0	40	40	0	0	0.0393701
Piney at Liverpool	950	100%	36	0	0	0	0	0	0	0	36	36	0	0	0.0393701
Pump Sta 3	970	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
Denver West	1010	100%	49	0	0	0	0	0	0	0	49	49	0	0	0.0393701
Lena @ U.S. Hwy 6	1040	100%	40	0	0	0	0	0	0	0	40	40	0	0	0.0393701
Jeffco Fairgrounds	1050	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Heritage Square	1060	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
Hidden Lake	1300	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
LDC at 64th	1310	100%	36	0	0	0	0	0	0	0	36	36	0	0	0.0393701
SPR at 3rd Ave	1320	100%	38	0	0	0	0	0	0	0	38	38	0	0	0.0393701
Denver Zoo	1360	100%	51	0	0	0	0	0	0	0	51	51	0	0	0.0393701
Wx-Diamond Hill	1420	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
Wx-Urban Farm	1460	100%	35	0	0	0	0	0	0	0	35	35	0	0	0.0393701
Third Creek at DIA	1480	100%	28	0	0	0	0	0	0	0	28	28	0	0	0.0393701

Wx-Marston Lake North	1520	100%	37	0	0	0	0	0	0	0	37	37	0	0	0.0393701
Lakewood CC	1550	100%	39	0	0	0	0	0	0	0	39	39	0	0	0.0393701
Wx-Brighton Ditch	1570	100%	24	0	0	0	0	0	0	0	24	24	0	0	0.0393701
Englewood Dam	1600	100%	54	0	0	0	0	0	0	0	54	54	0	0	0.0393701
SPR at Union Ave.	1640	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Sand Creek at mouth	1810	100%	33	0	0	0	0	0	0	0	33	33	0	0	0.0393701
Niver Detention	1900	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Wx-Salisbury Park	2730	100%	30	0	0	0	0	0	0	0	30	30	0	0	0.0393701
Wx-Castle Rock	2750	100%	31	0	0	0	0	0	0	0	31	31	0	0	0.0393701
Haskins Gulch Conf	2820	100%	43	0	0	0	0	0	0	0	43	43	0	0	0.0393701
Cottonwood (Apache)	2870	100%	41	0	0	0	0	0	0	0	41	41	0	0	0.0393701
Wx-Spring Valley Rd-DougCnty	2930	100%	29	0	0	0	0	0	0	0	29	29	0	0	0.0393701
Willow Creek - DougCnty	2940	100%	22	0	0	0	0	0	0	0	22	22	0	0	0.0393701
CC @ Prairie Canyon Ranch	3040	100%	22	0	0	0	0	0	0	0	22	22	0	0	0.0393701
Rio Grande	4020	100%	57	0	0	0	0	0	0	0	57	57	0	0	0.0393701
Walker Ranch	4050	100%	47	0	0	0	0	0	0	0	47	47	0	0	0.0393701
Bear Peak	4070	100%	50	0	0	0	0	0	0	0	50	50	0	0	0.0393701
Filter Plant	4100	100%	45	0	0	0	0	0	0	0	45	45	0	1	0.0393701
Betasso	4110	100%	67	0	0	0	0	0	0	0	67	67	0	0	0.0393701
Logan Mill	4140	100%	66	0	0	0	0	0	0	0	66	66	0	0	0.0393701
Sunshine	4160	100%	75	0	0	0	0	0	0	0	75	75	0	0	0.0393701
Pine Brook	4170	100%	45	0	0	0	0	0	0	0	45	45	0	0	0.0393701
Sunset	4240	100%	68	0	0	0	0	0	0	0	68	68	0	0	0.0393701
Wx-Louisville Lake	4750	100%	36	0	0	0	0	0	0	0	36	36	0	0	0.0393701
SBC@S Boulder Ditch	4840	100%	48	0	0	0	0	0	0	0	48	48	0	0	0.0393701
Trail Creek	5740	100%	40	0	0	0	0	0	0	0	40	40	0	0	0.0393701
Stump Bump	5810	100%	45	0	0	0	0	0	0	0	45	45	0	0	0.0393701
Hackett Mountain	5880	100%	49	0	0	0	0	0	0	0	49	49	0	0	0.0393701
Wx-Aurora Reservoir	900	100%	39	0	0	0	0	0	0	0	39	39	0	0	0.0393699
A2-Blackstone Precip	100100	100%	27	0	0	0	0	0	0	0	27	27	0	0	0.0393699
TOTAL			7789	266	36	7	2	1	15	8101	8487	386	3		
EPC at Hwy 105	3010	93%	138	9	1	0	0	0	0	148	159	11	0	0.01	
Porphyry Mtn	4850	83%	189	39	3	0	1	0	0	232	281	49	0	0.01	
Fairview Peak	4860	94%	192	12	0	0	0	0	0	204	216	12	0	0.01	

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