

# Memo



**Date:** April 3, 2009  
**To:** Kevin Stewart and Chad Kudym  
**From:** Markus Ritsch  
**Subject:** **March 2009 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 Nova Star 4.0 base station (ALERT 2) were analyzed for the period March 1 through March 31, 2009.

## II. General System Analysis Summary

A total of 265,225 data records were analyzed from the ALERT 2 base station. Meteorological sensors account for 84 percent, water level sensors 6 percent, and rain sensors 3 percent of the total monthly records.

More than ninety-eight percent (98%) of the received data reports were flagged as "good" by the Nova Star validation process.

The system-wide radio traffic loading was 8,556 reports per day with an average hourly loading of 356 reports. The peak hourly traffic loading was 802 reports, which occurred on March 7, between 11:00 PM and 12:00 PM. A plot of monthly average and peak hourly traffic loading is provided.

### ***A. Specific Issues Identified this Month***

- Rain Sensor 2330 has a large number of duplicate reports. It looks like the data from this sensor are received at the base through two different radio links. One of these links is poor because a large number of bit errors occur on this link. The District should consider modifying the pass/block list to block the re-broadcast of this sensor ID on the poor radio link.
- The ALERT2 base station was "down" on March 8, 2009 as no data reports were received on this day.
- ID 1373 is an open analog port on a rain-only transmitter. The transmitter should be re-programmed to turn off the analog port.
- More than 3,000 duplicate reports were received on ALERT2. Of these, Hiwan Golf Club has the largest number of duplicate reports on ALERT2.
- The peak hour of radio traffic (800 reports) occurred during a non-rain period and was composed entirely of met sensor reports.
- Spring Valley Road and Tomah Road are reporting their met parameters too frequently. These weather stations should be re-programmed to a 15-minute reporting interval.

### III. Rain Sensor Timer Reporting Summary

The following analysis assumes that each rain sensor has a 12-hour timer-reporting interval. System-wide, the ALERT 2 base station received approximately 52 percent of the non-incrementing timer reports. The worst performing rain sensors for the month are summarized (Table 1).

**Table 1. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)**

Jan	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2850	4030	2840									
1650	4200	1020									
1810	4490	1040									
4250	4520	1720									
4790	4790	1030									
4300	4020	1550									

\*-Timer statistics are skewed in these months because system start-up occurs. The network should be fully operational by April 1. Sensor ID 1460 has a 24-hour timer reporting interval and Sensor ID 1810 has an 18-hour timer-reporting interval.

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 2).

**Table 2. District-Wide Total Tip/Count Statistical Summary**

Statistical Parameter	Value	Comments
Mean	11.37	Only the 1-mm rain sensors were included in the analysis
Median	11	Only the 1-mm rain sensors were included in the analysis
Standard deviation	5.14	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	26.79	Only the 1-mm rain sensors were included in the analysis
Minimum total count	2	Many sensors
Maximum total count	31	Sanderson at Xavier (ID 1340)

The highest reporting rain sensor this month was Sanderson at Xavier (ID 1340) with 31 tips. A number of sensors reported high precipitation including 4810, 4360, 940, and 840. Irrigation sprinklers do not influence the sensors at this time of the year. Only one sensor reported more than the mean plus three standard deviations and this was Sanderson at Xavier.

#### a. Sanderson at Xavier (ID 1340)

This sensor is missing a large chunk of data between March 13 and March 23. The data series for the remainder of the month looks good. It is likely that field maintenance occurred at this station to cause the large jump.

Date/Time	Sensor ID	Count	Data Type
3/13/2009 1:37:46 PM	1340	1869	0
3/13/2009 1:41:03 PM	1340	1869	0
3/23/2009 11:39:46 AM	1340	1886	0
3/23/2009 12:11:06 PM	1340	1887	0

## B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 3).

**Table 3. 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										

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

Four sensors experienced a jump in sequential count of more than six (Table 4).

**Table 4. Sensors with a Jump of More than 6 in Sequential Count**

Sensor Description	Sensor ID	Comment
Sanderson at Xavier	1340	A large jump in tip count occurs between March 13 and March 23, 2009.
Carr Street	100	A large jump in tip count occurs on March 27, 2009.
Aurora Fire Station No. 12	840	A large jump in tip count occurs on March 27, 2009.
Bear Creek at Cub	2330	This sensor shows a number of duplicate reports. The data from this sensor may be received at the base station through more than one radio path. One of the reporting paths is marginal because the majority of reports through this path have 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 87.9 percent. A total of 1,269 incrementing reports were received and a total of 1,444 were expected. The total loss of incrementing reports for the month was approximately 12.12 percent. Those sensors with the worst rain event transmission performance characteristics are summarized (Table 5).

**Table 5. Monthly Summary of Sensors with the Most Missed Tips**

Jan	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
140	4030	860									
4490	4470	840									
1420	4490	700									
4040	4110	2840									
4160	4510	1340									
4470	4790	920									

\* - Event statistics are poor in February and March due to system start-up.

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 700 messages per hour are analyzed independently in an attempt to identify rain tip sequences where 3 or more, sequential messages are lost.

### A. The Heaviest Hourly Traffic Periods This Month

The hourly periods of highest radio traffic this month include:

Peak Traffic Periods	Reports/hour	Hour Beginning
Peak Hourly Traffic	802	3/7/2009 11:00 PM
2nd Max	774	3/7/2009 10:00 PM
3rd Max	734	3/7/2009 11:00 AM
4th Max	706	3/7/2009 10:00 AM
5th Max	694	3/7/2009 9:00 PM

### B. March 7, 2009

The heaviest traffic period occurred on March 7, between 9:00 PM and 11:59 PM. Incrementing rain records from the 1-mm gages for the heavy radio traffic period were examined to characterize the loss of sequential incrementing tip transmissions (Table 6). During the heavy traffic period, a total of 0 reports were expected and 0 were received yielding a loss of approximately 0.00% of the incrementing transmissions.

**Table 6. Peak Traffic Analysis - Loss of Incrementing Tip Reports**

Heavy Traffic Period (March 7)	Occurrences of lost sequential tip reports during period			
	Loss of 3 sequential tips	Loss of 4 sequential tips	Loss of 5 sequential tips	Loss of 6 or more sequential tips
9:00 PM to 11:00 PM	0	0	0	0

The heavy traffic period was composed primarily of meteorology reports. Incrementing reports from rain sensors did not occur during this period. It is interesting to note that the UDFCD network can generate over 800 reports per hour from only met sensors.

## 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 7).

**Table 7. Summary of Unknown IDs**

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	254
Total reports from unknown IDs	834
Unknown IDs with only a single received report (potential noise)	158
Total reports from all IDs – RecData Log entire month	265,225
Unknown reports as a fraction of total reports	0.31%

The total number of reports from unknown sensors is very small relative to the total reports received for the month.

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 8. Reports Received by Unknown IDs**

Unknown ID	Reports
1373*	185
727**	42
726**	40
721**	39
728**	39
722**	38
1319	12
2705	8
2768	8
4643	7
939	7
2808	6
1657	6
1631	6
4639	6
329	6
2719	5
4742	5
4199	5
2819	5
2743	5
2706	5
2736	5
2365	5

2739	5
4740	4
4646	4
4644	4
2715	4
1651	4
4831	4
2714	4
2756	4
2771	4
4756	4
2688	4
741	3
1019	3
4094	3
2745	3
2809	3
2624	3
2619	3
1777	3
4786	3
319	3
4759	3
609	3

\* - may be an open analog port on a rain only transmitter

\*\* - these reports were all received on March 14, 2009

The “unknown” device reports are analyzed temporally to understand when they are received during the day (Table 9). The goal of this analysis is to determine a pattern of occurrence that may correspond to a source of noise in the system, such as the use of a wireless microphone nearby.

**Table 9. Temporal Distribution of Unknown Reports**

Hour (AM)	Reports	Hour (PM)	Reports
0:00-00:59	19	12:00-12:59	35
1:00-1:59	32	1:00-1:59	47
2:00-2:59	8	2:00-2:59	19
3:00-3:59	19	3:00-3:59	27
4:00-4:59	22	4:00-4:59	40
5:00-5:59	12	5:00-5:59	12
6:00-6:59	21	6:00-6:59	18
7:00-7:59	176*	7:00-7:59	31
8:00-8:59	78*	8:00-8:59	10
9:00-9:59	36	9:00-9:59	17
10:00-10:59	51	10:00-10:59	41
11:00-11:59	45	11:00-11:59	18

\* - The majority of these reports were received on March 14<sup>th</sup> from sensor IDs 721, 722, 726, 727, and 728.

## VII. Issues Identified this Month

Sensors with a large number of invalid reports (duplicates/bit flip/contention errors/random decode):

Description	Sensor ID	Invalid Reports
Hiwan G.C.	2208	534
Hiwan G.C.	2209	358
Hiwan G.C.	2207	331
SPR at Dartmouth	1629	119
Quincy Reservoir	755	97
Evergreen Lake	2223	73
Barker Dam via Betasso WTP	4765	60
Magnolia	4095	59
Willow Creek - DougCnty	2948	59
Barker Dam via Betasso WTP	4763	58
Barker Dam via Betasso WTP	4762	57
Hiwan G.C.	2212	56
Castle Rock	2744	54
Hiwan G.C.	2214	53
Harvard @ Jackson	613	50
Hayman Stage	5929	46
Louisville Lake	4744	42
Hiwan G.C.	2213	42
Sugarloaf	4724	40
Cal-Wood Ranch	4772	37
Highlands Ranch WTP	2704	36
Cal-Wood Ranch	4767	36
Louisville Rec Ctr	1105	34
Cal-Wood Ranch	4774	34
Morrison	2333	33
Ward C-1	4704	32
Salisbury Park	2724	32
Holly Dam	1613	28
Cal-Wood Ranch	4764	28

A large number of duplicate reports are received from Hiwan G.C. A total of 3,200 duplicate reports were received from all sensors for the month.

**Rain sensors with a large number of invalid reports (bit flip/contention errors/random decode)**

<b>Rain Sensor ID</b>	<b>Data Type</b>	<b>Reports</b>
4770	1	9
5770	1	6
4200	1	4
1650	1	4
2750	1	4
100	1	3
4220	1	2
4790	1	2
4090	1	2

**Sensors reporting frequently (over reporting):**

<b>Description</b>	<b>Sensor ID</b>	<b>Reports</b>
Quincy Reservoir	749	7358
Spring Valley Road	2927	5259
Tomah Road	2991	5156
Tomah Road	2992	4411
Spring Valley Road	2932	4382
Castle Rock	2747	4358
Salisbury Park	2727	3962
Ward C-1	4707	3607
Hiwan G.C.	2208	3041
Aurora Reservoir	908	3003
Aurora Reservoir	903	2987

**Sensors reporting infrequently (under reporting):**

<b>Description</b>	<b>Sensor ID</b>	<b>Reports</b>
Bear Cr below Cub	2235	1
SPR at Dartmouth	1626	1
Bear Creek @ Lowell	1530	1
No Name @ Quincy	734	1
Quincy Reservoir	747	1
Kinney Peak	2276	1
Kelly Dam	414	1
Bear Creek @ Lowell	1535	1
Louisville Rec Cente/	1104	1
Toll Gate @ 6th	704	1
Sand Cr at Colfax	863	1
Englewood Dam	1605	1
Sand Cr at Colfax	865	1
SPR at Union Ave.	1640	2
Brighton Ditch Wx	1578	2
SPR at Union Ave.	1645	2
Cal-Wood Ranch	4280	2
Stapleton	1463	2
Harvard @ Jackson	614	2
Bear Creek @ Lowell	1533	2
Kelly Dam	415	2
Lena @ U.S. Hwy 6	1043	2
Magnolia	4089	3
Ferril Lake	1385	4
Kelly Dam	410	4



**Poor timer reporting:**

The following sensors showed poor timer performance this month.

<b>ID</b>	<b>Description</b>	<b>Performance</b>
1810	Sand Creek at mouth	10%
2840	Sulphur Gulch	16%
1020	Lena @ Nolte Pond	24%
1040	Lena @ U.S. Hwy 6	24%
1720	Cherry Cr @ Steele	24%
1030	NREL/S. Table Mtn.	27%
1550	Lakewood CC	27%
1610	Holly Dam	27%
1650	SPR at 19th Street	29%
1340	Sanderson at Xavier	32%
2810	Pine Cliff Road	37%
2820	Haskins Gulch Conf	40%
2920	West Cherry Head-Douglas Cnty	40%
2940	Willow Creek - DougCnty	40%
700	Toll Gate @ 6th	45%
1460	Stapleton	45%
100	Carr Street	48%
4470	Little Narrows	48%
1100	Louisville Rec Ctr	53%
1110	Gunbarrel	53%
4510	Pinewood Springs	53%
220	Upper Leyden	56%
4230	Golden Age	56%
1310	LDC at 64th	58%
4270	Cannon Mountain	58%
4340	Riverside	58%
4520	Eagle Ridge	58%
120	West Woods	60%
320	Sports Complex	60%
4030	Red Garden	60%
4160	Sunshine	60%
4790	Button Rock	60%
1300	Hidden Lake	61%
4020	Rio Grande	61%
4040	Martin Gulch	61%
4100	Filter Plant	61%
4250	Geer Canyon	61%
4290	Red Hill	61%
4300	Big Elk Park	61%
420	Expo Park	63%
850	Flying J	63%
4050	Walker Ranch	63%

**Poor event reporting:**

The following sensors showed poor event performance.

ID	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Bucket
860	26%	1	0	0	2	2	0	0	5	19	14	0.0393701
700	33%	2	0	1	1	0	1	0	5	15	10	0.0393701
840	33%	5	1	0	1	0	0	1	7	21	14	0.0393701
2840	38%	2	0	0	0	0	1	0	3	8	5	0.0393701
1340	45%	14	0	0	0	0	0	1	14	31	17	0.0393701
100	50%	7	0	0	0	0	0	1	7	14	7	0.0393701
920	50%	2	0	0	1	0	0	0	3	6	3	0.0393701
1630	50%	0	1	0	0	0	0	0	1	2	1	0.0393701
1460	57%	2	1	1	0	0	0	0	4	7	3	0.0393701
1810	60%	4	1	0	1	0	0	0	6	10	4	0.0393701
2730	67%	2	2	0	0	0	0	0	4	6	2	0.0393701
4170	70%	4	3	0	0	0	0	0	7	10	3	0.0393701
900	71%	3	2	0	0	0	0	0	5	7	2	0.0393699
640	73%	7	0	0	1	0	0	0	8	11	3	0.0393701
2820	73%	7	0	0	1	0	0	0	8	11	3	0.0393701
4070	73%	6	1	1	0	0	0	0	8	11	3	0.0393701
1570	75%	2	1	0	0	0	0	0	3	4	1	0.0393701
2330	75%	9	3	0	0	0	0	0	12	16	4	0.0393701
2940	75%	2	1	0	0	0	0	0	3	4	1	0.0393701
4470	75%	9	2	1	0	0	0	0	12	16	4	0.0393701
4730	75%	5	0	1	0	0	0	0	6	8	2	0.0393701
4820	79%	9	1	1	0	0	0	0	11	14	3	0.0393701

**Low rain total:**

Sensor ID	Tips
1630	2
410	2
2190	2
970	3
1050	3
2930	3

**High rain total:**

Sensor ID	Tips
840	21
2990	21
940	22
4360	23
4810	27
1340	31

# General System Analysis

**Database Name**

P:\A207-UDFCD-Data-Analysis\2009\03-2009\Novastar\_extract\_2009Mar.mdb

**First Date in Database**  
**Last Date in Database**

3/1/09 12:00 AM
3/31/09 11:59 PM

**Total Days**  
**Total Hours**

31.0
744.0

**Total Records Analyzed**

265225

**Records by Group**

Temperature	45909	17%
Wind Gust	45591	17%
Relative Humidity	43270	16%
Wind Speed Average & Azimuth	30582	12%
Barometric Pressure	24511	9%
Wind Direction	12893	5%
Wind Speed Average	11281	4%
Water Level PT-HSE	10351	4%
Solar Radiation	9619	4%
Precipitation	7781	3%
Battery Voltage HSE	5145	2%
Water Level Float	3822	1%
Battery Voltage Analog	3631	1%
Battery Voltage Digital	2768	1%
Water Level PT	1219	0%
Soil Moisture	905	0%
Fuel Temperature	793	0%
Fuel Moisture	781	0%
Repeater Status Report	484	0%
Longmont Water Level PT	442	0%
Hayman Precipitation	405	0%
Battery	399	0%
Repeater Pass List	366	0%
Wing Gust	320	0%
12Hr Status Report	311	0%
Hayman Battery	227	0%
Battery Voltage	146	0%
Longmont Flow Gage	81	0%
Hayman Stage	46	0%
Handar 585 ALARM Status	6	0%
Precipitation-ASCII	2	0%
Precipitation-Test	1	0%
<b>Total</b>	<b>264088</b>	

**Records by Major Group**

Meteorologic Sensors	223656	84%
Water Level Sensors	15915	6%
Sensor Status Transmissions	12711	5%
Rain Sensors	7783	3%
Soil and Fuel Sensors	2479	1%
<b>Total</b>	<b>262544</b>	

**Records by Validation Type**

Good	0	260779	98%
	ID	3264	1%
	1	808	0%
	II	374	0%
<b>Total</b>		<b>265225</b>	

**Sensors With Most Invalid Data**

Description	Sensor	Reports
Quincy Reservoir	755	97
Castle Rock	2744	54
Louisville Lake	4744	41
Sugarloaf	4724	38
Highlands Ranch WTP	2704	36

**Traffic Loading Summary**

Alert Reports	265225	
Average Daily Traffic	8556	
Average Hourly Traffic	356	
Median Hourly Traffic	355	hour beginning
Peak Hourly Traffic	802	3/7/09 11:00 PM
2nd Max	774	3/7/09 10:00 PM
3rd Max	734	3/7/09 11:00 AM
4th Max	706	3/7/09 10:00 AM
5th Max	694	3/7/09 9:00 PM

# Rain Timer Performance

Analyze Rain Sensors

systemwide average (days)

0.5147

77%

ID	Description	Rcv	Timer	Exp	Performance
1810	Sand Creek at mouth	6	11:59	62.00	10%
2840	Sulphur Gulch	10	19:00	62.00	16%
1020	Lena @ Nolte Pond	15	11:57	62.00	24%
1040	Lena @ U.S. Hwy 6	15	11:59	62.00	24%
1720	Cherry Cr @ Steele	15	11:58	62.00	24%
1030	NREL/S. Table Mtn.	17	11:58	62.00	27%
1550	Lakewood CC	17	11:57	62.00	27%
1610	Holly Dam	17	9:43	62.00	27%
1650	SPR at 19th Street	18	18:48	62.00	29%
1340	Sanderson at Xavier	20	10:30	62.00	32%
2810	Pine Cliff Road	23	13:15	62.00	37%
2820	Haskins Gulch Conf	25	12:00	62.00	40%
2920	West Cherry Head-Douglas Cnty	25	12:34	62.00	40%
2940	Willow Creek - DougCnty	25	11:55	62.00	40%
700	Toll Gate @ 6th	28	12:02	62.00	45%
1460	Stapleton	28	0:02	62.00	45%
100	Carr Street	30	18:54	62.00	48%
4470	Little Narrows	30	15:48	62.00	48%
1100	Louisville Rec Ctr	33	13:39	62.00	53%
1110	Gunbarrel	33	13:09	62.00	53%
4510	Pinewood Springs	33	14:15	62.00	53%
220	Upper Leyden	35	12:45	62.00	56%
4230	Golden Age	35	13:46	62.00	56%
1310	LDC at 64th	36	11:58	62.00	58%
4270	Cannon Mountain	36	13:50	62.00	58%
4340	Riverside	36	13:01	62.00	58%
4520	Eagle Ridge	36	12:21	62.00	58%
120	West Woods	37	11:58	62.00	60%
320	Sports Complex	37	15:59	62.00	60%
4030	Red Garden	37	12:42	62.00	60%
4160	Sunshine	37	13:01	62.00	60%
4790	Button Rock	37	12:21	62.00	60%
1300	Hidden Lake	38	11:58	62.00	61%
4020	Rio Grande	38	15:17	62.00	61%
4040	Martin Gulch	38	13:03	62.00	61%
4100	Filter Plant	38	12:40	62.00	61%
4250	Geer Canyon	38	12:39	62.00	61%
4290	Red Hill	38	13:03	62.00	61%
4300	Big Elk Park	38	13:22	62.00	61%
420	Expo Park	39	12:40	62.00	63%
850	Flying J	39	12:21	62.00	63%
4050	Walker Ranch	39	12:36	62.00	63%
4070	Bear Peak	39	12:58	62.00	63%
4360	Justice Center	39	12:58	62.00	63%
4110	Betasso	40	11:59	62.00	65%
4190	Slaughterhouse	40	11:58	62.00	65%
4200	Lazy Acres	40	12:21	62.00	65%
4350	Conifer Hill	40	12:39	62.00	65%
720	Confluence Pond	41	11:58	62.00	66%
4310	Johnny Park	41	11:57	62.00	66%
4490	Apple Valley	41	12:53	62.00	66%
4260	Taylor Mountain	42	14:07	62.00	68%
810	Granby Ditch @ 6th	44	11:57	62.00	71%
4530	Winiger Ridge	46	15:40	62.00	74%

2710	Highlands Ranch WTP	47	15:22	62.00	76%
130	Simms Street	48	13:00	62.00	77%
4140	Logan Mill	48	15:14	62.00	77%
200	Leyden Reservoir	49	12:14	62.00	79%
640	Goldsmith at Eastman	49	12:34	62.00	79%
4010	Crescent	49	14:34	62.00	79%
4080	Twin Sisters	49	15:05	62.00	79%
4560	Lyons Diversion NSV	49	14:45	62.00	79%
1370	West Metro FS13	50	13:53	62.00	81%
1050	Jeffco Fairgrounds	51	14:28	62.00	82%
2990	Tomah Rd-Douglas Cnty	51	10:17	62.00	82%
4130	Swiss Peaks	51	14:12	62.00	82%
4150	Gold Hill	51	13:30	62.00	82%
4710	Ward C-1	51	13:53	62.00	82%
330	Van Bibber @ Hwy 93	52	8:54	62.00	84%
630	Temple Pond at DTC	52	11:59	62.00	84%
4860	Fairview Peak	52	13:46	62.00	84%
4060	Lakeshore	53	13:55	62.00	85%
4570	St. Antons	53	12:43	62.00	85%
4750	Louisville Lake	53	13:58	62.00	85%
950	Piney at Liverpool	54	11:59	62.00	87%
2330	Morrison	54	12:34	62.00	87%
4850	Porphory Mtn	54	12:44	62.00	87%
650	Iliff Pond	55	11:44	62.00	89%
710	Horseshoe Park Drop	55	9:13	62.00	89%
840	Fire Station 12	55	12:01	62.00	89%
1710	Shop Creek	55	12:57	62.00	89%
4240	Sunset	55	13:22	62.00	89%
4730	Sugarloaf	55	12:57	62.00	89%
820	ETG @ Buckley	56	12:12	62.00	90%
870	Murphy Creek GC	56	12:01	62.00	90%
940	Sampson Gulch	56	11:06	62.00	90%
1570	Brighton Ditch Wx	56	12:26	62.00	90%
1900	Niver Detention	56	12:13	62.00	90%
2750	Castle Rock	56	12:04	62.00	90%
4220	Fling's	56	13:18	62.00	90%
610	Harvard @ Jackson	57	10:23	62.00	92%
1000	Maple Grove Resv.	57	12:55	62.00	92%
1010	Denver West	57	12:53	62.00	92%
4090	Magnolia	57	12:51	62.00	92%
4170	Pine Brook	57	12:41	62.00	92%
620	Quincy/Highline	58	12:39	62.00	94%
1660	SPR at Henderson	58	12:38	62.00	94%
4770	Cal-Wood Ranch	58	12:14	62.00	94%
300	Van Bibber Park	59	12:25	62.00	95%
500	Havana Park	59	11:59	62.00	95%
540	Parker/Mississippi	59	12:25	62.00	95%
800	Sable Ditch @ 18th	59	11:59	62.00	95%
970	Pump Sta 3	59	12:01	62.00	95%
1320	SPR at 3rd Ave	59	10:26	62.00	95%
1920	Brighton	59	12:42	62.00	95%
2190	Squaw Mountain	59	12:13	62.00	95%
2730	Salisbury Park	59	12:36	62.00	95%
440	Fire Station #7	60	12:12	62.00	97%
520	Jewell Detention	60	12:12	62.00	97%
760	Mission Viejo Park	60	12:11	62.00	97%
830	Side Creek Park	60	12:11	62.00	97%
920	Aurora Town Hall Wx	60	11:48	62.00	97%
1350	Chatfield COE	60	12:13	62.00	97%

1420	Diamond Hill	60	12:14	62.00	97%
310	Guy Hill Ranch	61	12:05	62.00	98%
750	Quincy Reservoir	61	11:59	62.00	98%
1060	Heritage Square	61	12:11	62.00	98%
1330	Roslyn	61	12:01	62.00	98%
4180	Gold Lake	61	11:56	62.00	98%
600	Harvard Gulch Park	62	10:13	62.00	100%
1630	SPR at Dartmouth	62	11:35	62.00	100%
150	Nott Creek	63	11:56	62.00	102%
530	Fire Station #19	63	11:46	62.00	102%
900	Aurora Reservoir	63	11:30	62.00	102%
2930	Spring Valley Rd - DougCnty	63	11:48	62.00	102%
860	Sand Cr at Colfax	66	6:40	62.00	106%
4820	Doudy Draw	67	11:16	62.00	108%
4840	SBC@S Boulder Ditch	68	10:48	62.00	110%
4830	SBC @ San Souci	73	10:36	62.00	118%
2210	Hiwan G.C.	79	9:07	62.00	127%
4810	Shanahan Ridge	80	9:59	62.00	129%
4550	Boulder Jail	81	9:31	62.00	131%
2220	Evergreen Lake	83	8:54	62.00	134%

Rain Event Performance		Reports Received	1269	Analyze Rain Sensors										
	Systemwide Avg	Total Tips	1444											
	87.9%	Data Loss	12.12%											
ID	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket	
860	26%	1	0	0	2	2	0	0	5	19	14	0	0.0393701	
840	33%	5	1	0	1	0	0	1	7	21	14	0	0.0393701	
700	33%	2	0	1	1	0	1	0	5	15	10	0	0.0393701	
2840	38%	2	0	0	0	0	1	0	3	8	5	0	0.0393701	
1340	45%	14	0	0	0	0	0	1	14	31	17	0	0.0393701	
100	50%	7	0	0	0	0	0	1	7	14	7	0	0.0393701	
1630	50%	0	1	0	0	0	0	0	1	2	1	0	0.0393701	
920	50%	2	0	0	1	0	0	0	3	6	3	0	0.0393701	
1460	57%	2	1	1	0	0	0	0	4	7	3	0	0.0393701	
1810	60%	4	1	0	1	0	0	0	6	10	4	0	0.0393701	
2730	67%	2	2	0	0	0	0	0	4	6	2	0	0.0393701	
4170	70%	4	3	0	0	0	0	0	7	10	3	0	0.0393701	
900	71%	3	2	0	0	0	0	0	5	7	2	0	0.0393699	
640	73%	7	0	0	1	0	0	0	8	11	3	0	0.0393701	
2820	73%	7	0	0	1	0	0	0	8	11	3	0	0.0393701	
4070	73%	6	1	1	0	0	0	0	8	11	3	0	0.0393701	
1570	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701	
2940	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701	
4730	75%	5	0	1	0	0	0	0	6	8	2	0	0.0393701	
2330	75%	9	3	0	0	0	0	0	12	16	4	0	0.0393701	
4470	75%	9	2	1	0	0	0	0	12	16	4	0	0.0393701	
4820	79%	9	1	1	0	0	0	0	11	14	3	0	0.0393701	
1660	80%	3	1	0	0	0	0	0	4	5	1	0	0.0393701	
600	80%	6	2	0	0	0	0	0	8	10	2	0	0.0393701	
750	82%	7	2	0	0	0	0	0	9	11	2	0	0.0393701	
4490	83%	4	1	0	0	0	0	0	5	6	1	0	0.0393701	
540	83%	8	2	0	0	0	0	0	10	12	2	0	0.0393701	
4020	83%	12	3	0	0	0	0	0	15	18	3	0	0.0393701	
1030	86%	5	1	0	0	0	0	0	6	7	1	0	0.0393701	
320	86%	10	2	0	0	0	0	0	12	14	2	0	0.0393701	
4220	86%	10	2	0	0	0	0	0	12	14	2	0	0.0393701	
2990	86%	15	3	0	0	0	0	0	18	21	3	1	0.0393701	
150	87%	11	2	0	0	0	0	0	13	15	2	0	0.0393701	
4110	87%	11	2	0	0	0	0	0	13	15	2	0	0.0393701	
220	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701	
4230	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701	
4140	88%	12	2	0	0	0	0	0	14	16	2	0	0.0393701	
1370	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701	
4510	88%	13	2	0	0	0	0	0	15	17	2	0	0.0393701	
300	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
4270	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
4790	89%	7	1	0	0	0	0	0	8	9	1	0	0.0393701	
850	89%	15	0	1	0	0	0	0	16	18	2	1	0.0393701	
1000	89%	14	2	0	0	0	0	0	16	18	2	0	0.0393701	
4840	89%	14	2	0	0	0	0	0	16	18	2	0	0.0393701	
4810	89%	21	3	0	0	0	0	0	24	27	3	0	0.0393701	
1100	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701	
1710	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701	
4550	90%	8	1	0	0	0	0	0	9	10	1	0	0.0393701	
4090	91%	9	1	0	0	0	0	0	10	11	1	0	0.0393701	
940	91%	18	2	0	0	0	0	0	20	22	2	0	0.0393699	
530	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701	
760	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701	
4010	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701	
650	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701	
4150	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701	
4570	92%	11	1	0	0	0	0	0	12	13	1	0	0.0393701	
200	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701	
330	93%	12	1	0	0	0	0	0	13	14	1	0	0.0393701	
4190	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701	
4200	94%	14	1	0	0	0	0	1	15	16	1	0	0.0393701	
1310	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701	
4290	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701	
610	94%	14	2	0	0	0	0	0	16	17	1	0	0.0393701	
1040	94%	15	1	0	0	0	0	0	16	17	1	1	0.0393701	
4530	94%	15	1	0	0	0	0	0	16	17	1	0	0.0393701	
810	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701	
4310	95%	17	1	0	0	0	0	0	18	19	1	0	0.0393701	
4770	100%	6	0	0	0	0	0	1	6	6	0	0	0.0393701	
410	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701	
2190	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701	
970	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	
1050	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701	

2930	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
2750	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
4160	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
4100	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
2710	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
2810	100%	6	0	0	0	0	0	0	6	6	0	1	0.0393701
4050	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
310	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
830	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
1060	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
1110	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
2210	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
2920	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
4060	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
4080	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
4710	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
1350	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
1900	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
4520	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
4750	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701
440	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
710	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
720	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
1300	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
1720	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
1920	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
4030	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
4240	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
4340	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
620	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
800	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
1010	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
4130	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
4250	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
4300	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
820	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
120	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
500	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
520	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
630	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
1330	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
4180	100%	12	0	0	0	0	0	0	12	12	0	0	0.0393701
420	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
870	100%	13	0	0	0	0	0	0	13	13	0	1	0.0393701
2320	100%	13	0	0	0	0	0	0	13	13	0	0	0.0393701
1320	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
1420	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
950	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
4260	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
4830	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
1550	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
4350	100%	16	0	0	0	0	0	0	16	16	0	0	0.0393701
4040	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
4360	100%	23	0	0	0	0	0	0	23	23	0	0	0.0393701
	<b>Total Tips</b>	<b>1165</b>	<b>85</b>	<b>7</b>	<b>8</b>	<b>2</b>	<b>2</b>	<b>5</b>	<b>1269</b>	<b>1444</b>	<b>175</b>	<b>5</b>	



