Memo

Water & Earth Technologies, Inc.
Water Resources and Environmental Consulting

Date: August 8, 2006

To: Kevin Stewart, Chad Kudym

From: Markus Ritsch

Subject: **July 2006 ALERT Data Analysis**

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 July 1 through July 31, 2006.

II. General System Analysis Summary

A total of 193,304 individual data records were analyzed. Meteorological sensors account for sixty-two (62) percent, water level sensors nineteen (19) percent, and rain sensors eleven (11) percent of the total transmissions.

Ninety-eight (98) percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly three thousand five hundred (3,467) reports were flagged as "bad". Of these "bad" reports, approximately two thirds (2,225) originated from the Wind Gust sensor (ID 2189) at Squaw Mountain. The reception of "bad" data reports from the Squaw Mountain sensor ID's 2189 and 2187 has been a consistent theme throughout this year.

The system-wide radio traffic loading was approximately six thousand two hundred (6,236) reports per day with an average hourly load of two hundred and sixty (260) reports. The peak hourly traffic loading was nine hundred and ninety (994) reports and occurred on July 7th between nine and ten in the evening. A plot of monthly average and peak hourly traffic loading is provided.

A new radio repeater was installed by Douglas County to relay the Hayman Burn precipitation gages on the District's primary base receiving frequency of 171.875 MHz. The new Douglas County repeater was activated on July 21, 2006 and configured to re-broadcast only those gages with IDs between 5700 through 6000. Just over five hundred (509) reports were attributable to the Hayman gages for the month of July. The impact upon radio traffic from these gages will be tracked throughout the flood season.

The sensors reporting most frequently this month include:

1. Boulder Creek at Broadway (ID 4583) this water level sensor reports once every fifteen minutes, and

2. Urban Farm (IDs 1464, 1466, 1465, 1467).

The reports from the above sensors are more-or-less distributed evenly throughout the month.

III. Rain Sensors Reporting This Month

Approximately one hundred and sixty seven (167) rain sensors had incrementing reports this month. This includes the Douglas County Hayman gages. Several rain sensors had non-incrementing timer reports but had no incrementing rain tip reports during the month (Table 1).

Table 1. Rain Sensors with No Tip Reports

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	1020	520	1020					
-----	-----	-----	-----	1610	540	1610					
-----	-----	-----	-----	2220	1020	2220					
-----	-----	-----	-----	4560	1610	4560					
-----	-----	-----	-----	-----	2220	-----					

-----	-----	-----	-----	-----	4240						
-----	-----	-----	-----	-----	4560						

* Jewell Detention (520), Parker/Mississippi (540), and Sunset (4240) have installed rain sensors. Lena at Nolte Pond (1020), Holly Dam (1610), Evergreen Lake (2220), and Lyons Diversion NSV (4560) do not have an installed rain sensor although they report the rain ID.

IV. Rain Sensor Timer Reporting Summary

The following summary assumes that all rain sensors have a 12-hour timer reporting interval. System-wide the base station (ALERT2) received seventy-eight (78) percent of the non-incrementing timer reports. Those rain sensors with the worst timer reporting performances are summarized (Table 2).

Table 2. Monthly Summary of Sensors with Poor Timer Performance

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1010	1460	1460	2340	1460	1460	1460					
1460	1660	4820	1460	1330	4820	1440					
1640	4240	4570	1330	540	4830	110					
--	--	--	1610	1600	1600	4820					
			1600	4820	2350	4220					

* Stapleton "Urban Farm" (1460), Elbert (1440), Ralston Reservoir (110), Doudy Draw (4820), Fling's (4220).

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. For example, sensor 4820 consistently exhibits a poor timer performance value.

We suspect that sensor 1460 has a 24-hour timer reporting interval so it's timer performance value is actually better than reported here (see data analysis report for May, 2006).

V. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from the 1-mm rain sensors were analyzed to quantify the District-wide statistical total monthly tip summary (Table 3).

Table 3. July District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	74.03	Only the 1-mm rain sensors were included in the analysis
Median	73	Only the 1-mm rain sensors were included in the analysis
Standard deviation	27.66	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	157.02	Several sensors for the month are outside the Mean +/- 3 Std Dev
Minimum total count	6	Shop Creek (ID 1710)
Maximum total count	167	Squaw Mountain (ID 2190)

A monthly summary of the District-wide mean total tip/count is presented (Table 4).

Table 4. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.62	5.92	18.39	20.47	19.44	13.75	74.03					

The following sensor had a maximum total tip count that exceeded the system-wide mean plus three standard deviations for the month:

1. Squaw Mountain, ID 2190

1. Squaw Mountain (ID 2190)

The rain tip count series for the month looks reasonable for Squaw Mountain. The series starts with a value of 366 on July 1 and ends with a value of 533 on July 31. The count series jumps significantly on July 7th, July 8th and July 9th. The curious aspect of the series is the absence of data for the period July 15th through July 17th (Figure 1).
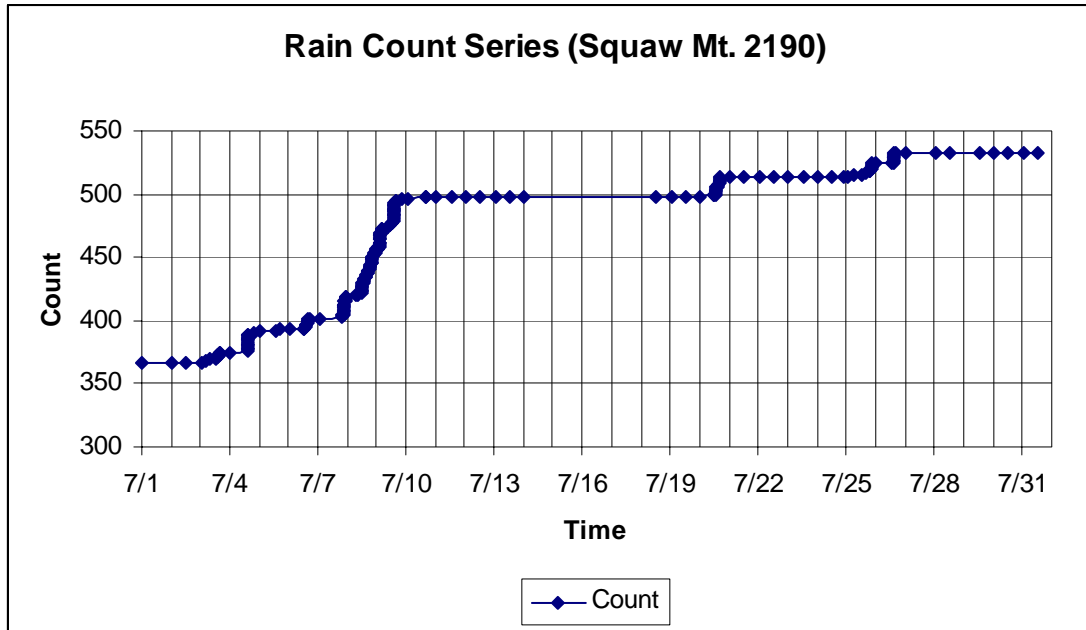
Figure 1. Monthly Count Series for Squaw Mountain (ID 2190)

A closer inspection of all data records shows that the base station received no data between July 14th at 5:24:18 PM and July 18th at 9:06:00 AM. No data was collected for a period of approximately three (3) days.

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

The following rain sensors experienced a jump in their sequential tip count of more than six (6). The data records for these sensors were visually inspected to determine the cause of the large jump.

1. Nott Creek, ID150
2. Expo Park, ID 420
3. Temple Pond at DTC, ID 630
4. Quincy Reservoir, ID 750
5. Genesee Village, ID 2310
6. Idledale, ID 2350
7. Doudy Draw, ID 4820

1. Nott Creek, ID 150

On July 7th the count value jumps from 92 to 97 to 105. The count value of 97 is processed as an erroneous data value by NovaStar. The count value of 97 is probably correct but was found to be invalid due to the lack of additional incrementing reports.

Date/Time	Sensor ID	Count	Data Type
7/6/2006 11:04:07 PM	150	92	0
7/7/2006 11:04:06 AM	150	92	0
7/7/2006 9:02:05 PM	150	97	1
7/7/2006 10:04:54 PM	150	105	0
7/7/2006 10:11:19 PM	150	106	0

2. Expo Park, ID 420

A jump of nine (9) counts occurred between July 14th and July 18th when the base station was down.

3. Temple Pond at DTC, ID 630

A jump of eight (8) counts occurred between July 14th and July 18th when the base station was down.

4. Quincy Reservoir, ID 750

On July 2nd the count value jumps from 10 to 26. For some reason, the large jump is processed as a valid data point by NovaStar. A total of sixteen (16) single increment tip count values were not received by the base station in a twenty-six minute period in the evening of July 2nd.

Date/Time	Sensor ID	Count	Data Type
7/2/2006 4:57:00 PM	750	7	0
7/2/2006 5:00:28 PM	750	10	0
7/2/2006 5:26:33 PM	750	26	0
7/2/2006 5:40:38 PM	750	28	0
7/2/2006 6:04:14 PM	750	29	0

5. Genesee Village, ID 2310

On July 7th the count value jumps from 79 to 86 to 92. The count value of 86 is processed as an erroneous data value by NovaStar. The count value of 86 is probably correct but was found to be invalid due to the lack of additional incrementing reports.

Date/Time	Sensor ID	Count	Data Type
7/6/2006 12:23:20 PM	2310	76	0
7/6/2006 4:20:14 PM	2310	79	0
7/7/2006 8:30:08 PM	2310	86	1
7/7/2006 8:50:19 PM	2310	92	0
7/7/2006 8:55:49 PM	2310	94	0
7/7/2006 9:03:17 PM	2310	96	0

6. Idledale, ID 2350

On July 7th and July 8th the count value jumps from 22 to 37 to 48. The count value of 37 is processed as an erroneous data value by NovaStar. The count value of 37 is probably correct but was found to be invalid due to the lack of additional incrementing reports.

Date/Time	Sensor ID	Count	Data Type
7/7/2006 2:15:51 PM	2350	22	0
7/7/2006 8:49:04 PM	2350	37	1
7/8/2006 2:15:49 AM	2350	48	0
7/8/2006 9:21:48 AM	2350	49	0

7. Doudy Draw, ID 4820

Between July 8th and July 10th, the count series jumps from 84 to 110 then continues up. No data transmissions were received on July 9th. This station failed to report on July 9th during a period of significant rainfall.

Date/Time	Sensor ID	Count	Data Type
7/8/2006 1:08:39 PM	4820	80	0
7/8/2006 1:39:06 PM	4820	83	0
7/8/2006 2:07:44 PM	4820	84	0
7/10/2006 8:23:25 AM	4820	110	0
7/10/2006 8:21:26 PM	4820	110	0

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing rain tip reports for the month was eighty-seven (87) percent. A total of 9,575 incrementing reports were received and a total of 10,999 were expected. The total loss of incrementing reports was approximately thirteen (13) percent. Those sensors with the worst rain event transmission 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
640	4010	4530	2190	540	4820	4820					
1640	4080	4170	310	1400	1350	2350					
4490	4170	4820	4820	1100	4790	2310					
-----	-----	-----	-----	4820	2340	750					
-----	-----	-----	-----	1420	2350	150					

* Doudy Draw (4820), Idledale (2350), Genesee Village (2310), Quincy Reservoir (750), Nott Creek (150)

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.

The sensors with poor rain tip performance in June all experience jumps in sequential count values during the heavy rain period from July 7th through July 9th.

Also, the fact that the base station did not receive data between July 14th at 5:24:18 PM and July 18th at 9:06:00 AM contributed to the lower-than-expected data reception rate.

VI. Issues Continued from Previous Month

The following issues were identified last month.

1. Doudy Draw (4820) exhibits both poor timer and event transmission performance.

2. The PT at Boulder Creek at Broadway (ID 4583) reports every fifteen (15) minutes.

3. The timer reporting interval for Stapleton sensor 1460 (rain) is twenty-four (24) hours, **not** twelve (12) hours as expected. The timer reports are received each day at approximately 11:57:20 pm.

VII. Issues Identified this Month

Further investigation into the following issues is recommended:

1. The base station received no data between July 14th at 5:24:18 PM and July 18th at 9:06:00 AM. No data was collected for a period of approximately three (3) days. This contributed to the low rain timer and event performance statistics.

2. The significant and at times heavy rain experienced between July 7th and July 9th caused the loss of sequential single increment data transmissions from numerous rain sensors within the District system. The District's archival database should be inspected and rain sensors that under-reported during this period should be confirmed and corrected.

3. Doudy Draw (4820) continues to exhibit both poor timer and event transmission performance. On July 9th, during a significant rainfall period, this station failed to report even a single tip of rain. The value of a rain gage that can not consistently report rainfall during a period of potential flooding must be questioned by the District. What good is this rain sensor in a flood detection network?

Database Name	P:\A207-UDFCD-Data-Analysis\2006_July\Novastar_extract_200607.mdb		

First Date in Database	7/1/06 12:00 AM	**Total Days**	31.0
Last Date in Database	7/31/06 11:59 PM	**Total Hours**	744.0

Total Records Analyzed 193304

Records by Group

Description	Records	Percent
Water Level PT-HSE	29288	15%
Wind Gust	29185	15%
Relative Humidity	25235	13%
Temperature	23141	12%
Precipitation	20329	11%
Wind Direction	15460	8%
Wind Speed Average & Azimuth	11874	6%
Wind Speed Average	9930	5%
Battery Voltage HSE	5220	3%
Battery Voltage Digital	4905	3%
Water Level Float	3931	2%
Solar Radiation	3847	2%
Water Level PT	3650	2%
Barometric Pressure	1711	1%
Fuel Moisture	1255	1%
Fuel Temperature	1247	1%
Repeater Pass List	853	0%
Handar 585 ALARM Status	704	0%
Hayman Precipitation	509	0%
Battery Voltage Analog	462	0%
Longmont Flow Gage	209	0%
12Hr Status Report	205	0%
Soil Moisture	103	0%
Longmont Water Level PT	48	0%
Precipitation-ASCII	3	0%
Total	**193304**	

Records by Major Group

Description	Records	Percent
Meteorologic Sensors	120383	62%
Water Level Sensors	37126	19%
Rain Sensors	20332	11%
Sensor Status Transmissions	12349	6%
Soil and Fuel Sensors	2605	1%
Total	**192795**	

Records by Validation Type

Description	Code	Records	Percent
Good	0	189837	98%
Questionable	1	3467	2%
	Total	**193304**	

Sensors With Most Invalid Data

Description	Sensor	Reports
Squaw Mountain	2189	2225
Squaw Mountain	2187	603
Quincy Reservoir	753	102
Louisville Rec Ctr	1103	48
Louisville Lake	4744	42

Traffic Loading Summary

Alert Reports	193304	
Average Daily Traffic	6236	
Average Hourly Traffic	260	
Median Hourly Traffic	267	hour beginning
Peak Hourly Traffic	994	7/7/06 9:00 PM

Total Number of Sensors Defined	**Total Number of Sensors Reporting**
806	531

Reports per Sensor

Description	Sensor	Reports	Fraction of Total
Boulder Cr at Broadway	4583	2534	1%
Urban Farm	1464	2511	1%
Urban Farm	1466	2502	1%
Marston Lake North	1526	2486	1%
Marston Lake North	1521	2480	1%
Urban Farm	1465	2473	1%
Urban Farm	1467	2452	1%
Green Ditch	4593	2452	1%
Elbert	1439	2442	1%
Squaw Mountain	2189	2412	1%
Salisbury Park	2727	2296	1%
Squaw Mountain	2188	2293	1%
Squaw Mountain	2187	2258	1%
Castle Rock	2744	2242	1%
Hiwan G.C.	2208	2210	1%
Salisbury Park	2724	2181	1%
Elbert	1438	2177	1%
Sugarloaf	4724	2156	1%
SPR at Union Ave.	1643	2094	1%
SPR at 19th Street	1649	2093	1%
Blue Mountain	138	2082	1%
Englewood Dam	1603	2056	1%

Rain Timer Performance

Rain Sensors	Description	Received Timer Reports	systemwide average (days) 0.6218 Average Timer Interval	Expected Timer Reports	Systemwide Average 78% Performance
100	Carr Street	49	14:28	62.00	79%
110	Ralston Reservoir	37	19:26	62.00	60%
120	West Woods	48	15:38	62.00	77%
140	Blue Mountain	53	14:27	62.00	85%
150	Nott Creek	44	14:54	62.00	71%
200	Leyden Reservoir	50	14:45	62.00	81%
210	Leyden Confluence	49	15:15	62.00	79%
220	Upper Leyden	48	14:46	62.00	77%
300	Van Bibber Park	50	14:39	62.00	81%
310	Guy Hill Ranch	44	15:23	62.00	71%
330	Van Bibber @ Hwy 93	51	14:20	62.00	82%
400	Montview Park	45	16:32	62.00	73%
410	Kelly Dam	48	14:48	62.00	77%
420	Expo Park	46	12:45	62.00	74%
430	Utah Park	48	12:51	62.00	77%
440	Fire Station #7	50	15:12	62.00	81%
500	Havana Park	48	15:29	62.00	77%
510	Virginia Court	47	11:57	62.00	76%
520	Jewell Detention	44	16:11	62.00	71%
530	Fire Station #19	49	14:31	62.00	79%
540	Parker/Mississippi	48	15:33	62.00	77%
600	Harvard Gulch Park	51	14:25	62.00	82%
610	Harvard @ Jackson	53	14:13	62.00	85%
620	Quincy/Highline	52	14:23	62.00	84%
630	Temple Pond at DTC	43	11:57	62.00	69%
640	Goldsmith @ Eastman	50	11:59	62.00	81%
650	Iliff Pond	51	14:18	62.00	82%
700	Toll Gate @ 6th	50	14:27	62.00	81%
710	Horseshoe Park Drop	51	14:39	62.00	82%
720	Confluence Pond	50	12:16	62.00	81%
730	No Name @ Quincy	47	15:44	62.00	76%
740	Smoky Hill	53	14:17	62.00	85%
750	Quincy Reservoir	48	14:35	62.00	77%
760	Mission Viejo Park	50	14:57	62.00	81%
800	Sable Ditch @ 18th	49	15:20	62.00	79%
810	Granby Ditch @ 6th	48	16:04	62.00	77%
820	ETG @ Buckley	51	14:39	62.00	82%
830	Side Creek Park	51	15:33	62.00	82%
840	Fire Station 12	48	14:46	62.00	77%
850	Flying J	52	14:17	62.00	84%
860	Sand Cr at Colfax	99	7:23	62.00	160%
870	Murphy Creek GC	49	15:00	62.00	79%
900	Aurora Reservoir	49	15:09	62.00	79%
1000	Maple Grove Resv.	50	14:57	62.00	81%
1010	Denver West	49	14:39	62.00	79%
1020	Lena @ Nolte Pond	51	14:23	62.00	82%
1030	NREL/S. Table Mtn.	50	15:10	62.00	81%
1040	Lena @ U.S. Hwy 6	51	14:08	62.00	82%
1050	Jeffco Fairgrounds	50	14:57	62.00	81%
1060	Heritage Square	48	15:20	62.00	77%
1100	Louisville Rec Ctr	43	17:48	62.00	69%
1110	Gunbarrel	50	14:42	62.00	81%
1200	Broomfield 3207	48	14:43	62.00	77%
1300	Hidden Lake	50	14:49	62.00	81%
1310	LDC at 64th	47	15:38	62.00	76%
1320	SPR at 3rd Ave	49	15:31	62.00	79%
1330	Roslyn	51	14:55	62.00	82%
1340	Sanderson at Xavier	51	14:50	62.00	82%
1350	Chatfield COE	41	15:59	62.00	66%
1360	Denver Zoo	51	14:24	62.00	82%
1370	West Metro FS13	49	12:36	62.00	79%
1400	Upper Sloan Det.	48	15:38	62.00	77%
1420	Diamond Hill	52	14:38	62.00	84%
1440	Elbert	27	13:20	62.00	44%
1460	Urban Farm	26	4:55	62.00	42%
1480	Third Creek at DIA	48	16:00	62.00	77%
1500	Powers Park	48	12:21	62.00	77%
1520	Marston Lake North	52	14:30	62.00	84%
1530	Bear Creek @ Lowell	50	15:14	62.00	81%
1600	Englewood Dam	49	15:50	62.00	79%
1610	Holly Dam	51	14:21	62.00	82%
1620	Slaughterhouse Glch	44	15:43	62.00	71%
1640	SPR at Union Ave.	50	14:20	62.00	81%
1660	SPR at Henderson	49	14:38	62.00	79%

1700	Cherry Cr @ Champa	51	14:17	62.00	82%
1710	Shop Creek	52	14:17	62.00	84%
1720	Cherry Cr @ Steele	53	13:30	62.00	85%
1800	Sand Creek Park	44	16:53	62.00	71%
1810	Sand Creek at mouth	47	15:23	62.00	76%
1900	Niver Detention	51	14:28	62.00	82%
1920	Brighton	51	14:10	62.00	82%
2190	Squaw Mountain	44	16:36	62.00	71%
2210	Hiwan G.C.	53	14:35	62.00	85%
2220	Evergreen Lake	51	14:21	62.00	82%
2230	Bear Cr below Cub	44	15:38	62.00	71%
2240	Cold Sprg Glch conf	46	16:38	62.00	74%
2250	Rosedale	44	15:25	62.00	71%
2260	Brook Forest	50	15:43	62.00	81%
2270	Cub Cr below Blue	50	14:32	62.00	81%
2280	Kinney Peak	52	14:20	62.00	84%
2310	Genesee Village	48	14:31	62.00	77%
2330	Morrison	48	15:25	62.00	77%
2340	El Rancho	46	16:11	62.00	74%
2350	Idledale	46	14:35	62.00	74%
2360	Indian Hills	46	15:22	62.00	74%
2370	Red Rocks Park	45	16:21	62.00	73%
2710	Highlands Ranch WTP	51	15:04	62.00	82%
2730	Salisbury Park	47	16:35	62.00	76%
2750	Castle Rock	53	14:20	62.00	85%
2810	Pine Cliff Road	48	15:52	62.00	77%
2820	Haskins Gulch Conf	49	15:46	62.00	79%
2840	Sulphur Gulch	49	14:54	62.00	79%
4010	Cresent	49	12:19	62.00	79%
4020	Rio Grande	49	15:07	62.00	79%
4030	Red Garden	53	14:45	62.00	85%
4040	Martin Gulch	45	16:04	62.00	73%
4050	Walker Ranch	49	11:58	62.00	79%
4060	Lakeshore	46	12:19	62.00	74%
4070	Bear Peak	51	14:57	62.00	82%
4080	Twin Sisters	42	13:53	62.00	68%
4090	Magnolia	48	12:11	62.00	77%
4100	Filter Plant	49	15:31	62.00	79%
4110	Betasso	51	15:19	62.00	82%
4130	Swiss Peaks	45	13:14	62.00	73%
4140	Logan Mill	50	12:19	62.00	81%
4150	Gold Hill	43	12:55	62.00	69%
4160	Sunshine	49	15:08	62.00	79%
4170	Pine Brook	45	15:39	62.00	73%
4180	Gold Lake	47	11:57	62.00	76%
4190	Slaughterhouse	48	11:58	62.00	77%
4200	Lazy Acres	47	16:34	62.00	76%
4220	Fling's	40	17:24	62.00	65%
4230	Golden Age	50	15:12	62.00	81%
4240	Sunset	42	12:55	62.00	68%
4250	Geer Canyon	51	15:02	62.00	82%
4260	Taylor Mountain	50	12:22	62.00	81%
4270	Cannon Mountain	48	15:57	62.00	77%
4290	Red Hill	43	15:08	62.00	69%
4300	Big Elk Park	50	12:20	62.00	81%
4310	Johnny Park	51	15:02	62.00	82%
4330	Indian Ruins	49	15:26	62.00	79%
4340	Riverside	49	12:19	62.00	79%
4350	Conifer Hill	51	15:29	62.00	82%
4360	Justice Center	49	15:11	62.00	79%
4470	Little Narrows	44	16:36	62.00	71%
4490	Apple Valley	49	15:25	62.00	79%
4510	Pinewood Springs	42	17:04	62.00	68%
4520	Eagle Ridge	50	14:55	62.00	81%
4530	Winiger Ridge	43	16:59	62.00	69%
4560	Lyons Diversion NSV	47	15:53	62.00	76%
4570	St. Antons	48	15:04	62.00	77%
4710	Ward C-1	48	15:46	62.00	77%
4730	Sugarloaf	50	12:41	62.00	81%
4750	Louisville Lake	51	14:27	62.00	82%
4770	Cal-Wood Ranch	48	16:14	62.00	77%
4790	Button Rock	48	15:16	62.00	77%
4810	Shanahan Ridge	43	17:02	62.00	69%
4820	Doudy Draw	38	16:45	62.00	61%
4830	SBC @ San Souci	42	17:12	62.00	68%
4840	SBC@S Boulder Ditch	45	15:12	62.00	73%
4850	Porphory Mtn	47	11:59	62.00	76%
4860	Fairview Peak	48	12:21	62.00	77%

Rain Event Performance

		Reports Received	9575		Analyze Rain Sensors								
	Systemwide Avg	Total Tips	10999										
	87%	Data Loss	12.95%										

Rain Sensor	Total Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Actual Tips	Expected Tips	Missed Tips	Hold-off	TB Size
100	86%	38	5	1	0	0	0	0	44	51	7	0	0.0393701
110	74%	24	3	0	1	1	0	0	29	39	10	0	0.0393701
120	90%	60	5	1	0	0	0	0	66	73	7	0	0.0393701
140	91%	55	6	0	0	0	0	0	61	67	6	0	0.0393701
150	69%	57	9	2	0	0	1	1	69	100	18	0	0.0393701
200	93%	57	5	0	0	0	0	0	62	67	5	0	0.0393701
210	92%	51	2	0	1	0	0	0	54	59	5	0	0.0393701
220	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701
300	94%	64	4	0	0	0	0	0	68	72	4	0	0.0393701
310	86%	54	8	1	0	0	0	0	63	73	10	0	0.0393701
330	84%	57	9	2	0	0	0	0	68	81	13	18	0.0393701
400	87%	52	4	1	1	0	0	0	58	67	9	0	0.0393701
410	85%	45	5	2	0	0	0	0	52	61	9	0	0.0393701
420	82%	50	3	0	0	0	0	1	53	65	3	0	0.0393701
430	91%	77	8	0	0	0	0	0	85	93	8	0	0.0393701
440	89%	65	7	1	0	0	0	0	73	82	9	0	0.0393701
500	89%	45	4	1	0	0	0	0	50	56	6	0	0.0393701
510	91%	74	6	1	0	0	0	0	81	89	8	0	0.0393701
520	90%	51	6	0	0	0	0	0	57	63	6	0	0.0393701
530	87%	52	5	2	0	0	0	0	59	68	9	0	0.0393701
540	91%	54	4	1	0	0	0	0	59	65	6	0	0.0393701
600	98%	82	2	0	0	0	0	0	84	86	2	0	0.0393701
610	91%	52	6	0	0	0	0	0	58	64	6	0	0.0393701
620	88%	45	5	1	0	0	0	0	51	58	7	0	0.0393701
630	82%	98	10	2	1	0	0	1	111	136	17	0	0.0393701
640	94%	105	4	0	1	0	0	0	110	117	7	0	0.0393701
650	82%	45	6	3	0	0	0	0	54	66	12	0	0.0393701
700	82%	47	6	3	0	0	0	0	56	68	12	0	0.0393701
710	88%	59	9	0	0	0	0	0	68	77	9	0	0.0393701
720	82%	77	14	3	0	0	0	0	94	114	20	0	0.0393701
730	84%	63	15	0	0	0	0	0	78	93	15	0	0.0393701
740	96%	73	3	0	0	0	0	0	76	79	3	0	0.0393701
750	65%	39	3	1	1	0	0	1	44	68	8	0	0.0393701
760	84%	67	11	2	0	0	0	0	80	95	15	0	0.0393701
800	83%	37	7	1	0	0	0	0	45	54	9	0	0.0393701
810	88%	58	7	1	0	0	0	0	66	75	9	0	0.0393701
820	83%	58	15	0	0	0	0	0	73	88	15	0	0.0393701
830	82%	103	20	4	0	0	0	0	127	155	28	0	0.0393701
840	92%	50	3	1	0	0	0	0	54	59	5	0	0.0393701
850	88%	39	4	1	0	0	0	0	44	50	6	0	0.0393701
860	93%	13	1	0	0	0	0	0	14	15	1	0	0.0393701
870	87%	108	12	3	0	0	0	0	123	141	18	2	0.0393701
900	94%	68	5	0	0	0	0	0	73	78	5	0	0.0393699
1000	85%	38	5	0	1	0	0	0	44	52	8	0	0.0393701
1010	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701
1030	84%	34	8	0	0	0	0	0	42	50	8	0	0.0393701
1040	88%	38	6	0	0	0	0	0	44	50	6	0	0.0393701
1050	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701
1060	88%	46	7	0	0	0	0	0	53	60	7	0	0.0393701
1100	88%	54	6	1	0	0	0	0	61	69	8	0	0.0393701
1110	82%	32	7	1	0	0	0	0	40	49	9	0	0.0393701
1200	85%	28	4	1	0	0	0	0	33	39	6	0	0.0393701
1300	89%	27	4	0	0	0	0	0	31	35	4	0	0.0393701
1310	90%	23	3	0	0	0	0	0	26	29	3	0	0.0393701
1320	94%	43	3	0	0	0	0	0	46	49	3	0	0.0393701
1330	93%	36	1	1	0	0	0	0	38	41	3	0	0.0393701
1340	80%	28	5	2	0	0	0	0	35	44	9	0	0.0393701
1350	87%	69	6	3	0	0	0	0	78	90	12	0	0.0393701
1360	85%	15	1	1	0	0	0	0	17	20	3	0	0.0393701
1370	94%	42	3	0	0	0	0	0	45	48	3	0	0.0393701
1400	92%	31	1	1	0	0	0	0	33	36	3	0	0.0393701
1420	88%	38	6	0	0	0	0	0	44	50	6	0	0.0393701
1440	91%	64	5	1	0	0	0	0	70	77	7	0	0.0393701
1460	94%	45	3	0	0	0	0	0	48	51	3	0	0.0393701
1480	90%	32	2	1	0	0	0	0	35	39	4	0	0.0393701
1500	88%	82	8	1	1	0	0	0	92	105	13	0	0.0393701
1520	77%	21	4	2	0	0	0	0	27	35	8	0	0.0393701
1530	77%	22	7	1	0	0	0	0	30	39	9	0	0.0393701
1600	81%	51	7	2	1	0	0	0	61	75	14	0	0.0393701
1620	82%	44	3	2	0	1	0	0	50	61	11	0	0.0393701
1640	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701
1660	85%	28	6	0	0	0	0	0	34	40	6	0	0.0393701
1700	86%	49	5	2	0	0	0	0	56	65	9	0	0.0393701
1710	100%	6	0	0	0	0	0	0	6	6	0	1	0.0393701
1720	86%	81	7	4	0	0	0	0	92	107	15	24	0.0393701
1800	83%	33	6	1	0	0	0	0	40	48	8	0	0.0393701
1810	96%	44	2	0	0	0	0	0	46	48	2	0	0.0393701
1900	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701
1920	91%	38	4	0	0	0	0	0	42	46	4	0	0.0393701
2190	95%	149	9	0	0	0	0	0	158	167	9	0	0.0393701
2210	93%	69	6	0	0	0	0	0	75	81	6	0	0.0393701
2230	88%	75	8	0	1	0	0	0	84	95	11	2	0.0393701
2240	90%	74	5	2	0	0	0	0	81	90	9	0	0.0393701
2250	94%	112	6	1	0	0	0	0	119	127	8	1	0.0393701
2260	94%	115	8	0	0	0	0	0	123	131	8	1	0.0393701
2270	95%	92	3	1	0	0	0	0	96	101	5	0	0.0393701
2280	86%	67	8	1	1	0	0	0	77	90	13	1	0.0393701
2310	58%	35	12	4	2	0	0	1	53	92	26	0	0.0393701
2320	88%	73	7	2	0	0	0	0	82	93	11	0	0.0393701
2330	92%	45	4	0	0	0	0	0	49	53	4	0	0.0393701
2340	80%	50	8	2	1	0	0	0	61	76	15	0	0.0393701
2350	53%	36	5	2	0	1	0	1	44	83	13	0	0.0393701
2360	88%	82	9	0	0	1	0	0	92	105	13	0	0.0393701
2370	76%	29	6	1	0	1	0	0	37	49	12	0	0.0393701
2710	94%	58	1	0	1	0	0	0	60	64	4	0	0.0393701
2730	87%	57	6	2	0	0	0	0	65	75	10	0	0.0393701
2750	92%	76	7	0	0	0	0	0	83	90	7	0	0.0393701
2810	85%	63	11	1	0	0	0	0	75	88	13	0	0.0393701

2820	91%	113	11	1	0	0	0	0	125	138	13	0	0.0393701
2840	88%	92	11	2	0	0	0	0	105	120	15	0	0.0393701
4010	77%	33	9	2	0	0	0	0	44	57	13	0	0.0393701
4020	91%	72	8	0	0	0	0	0	80	88	8	0	0.0393701
4030	94%	81	6	0	0	0	0	0	87	93	6	0	0.0393701
4040	91%	77	8	0	0	0	0	0	85	93	8	0	0.0393701
4050	91%	61	5	1	0	0	0	0	67	74	7	0	0.0393701
4060	76%	44	12	1	0	1	0	0	58	76	18	0	0.0393701
4070	94%	80	5	0	0	0	0	0	85	90	5	0	0.0393701
4080	87%	79	8	3	0	0	0	0	90	104	14	0	0.0393701
4090	87%	57	10	0	0	0	0	0	67	77	10	0	0.0393701
4100	100%	70	0	0	0	0	0	0	70	70	0	0	0.0393701
4110	95%	70	2	1	0	0	0	0	73	77	4	0	0.0393701
4130	78%	62	15	4	0	0	0	0	81	104	23	0	0.0393701
4140	86%	63	10	1	0	0	0	0	74	86	12	0	0.0393701
4150	86%	85	14	1	0	0	0	0	100	116	16	0	0.0393701
4160	95%	97	5	0	0	0	0	0	102	107	5	0	0.0393701
4170	87%	40	5	1	0	0	0	0	46	53	7	0	0.0393701
4180	87%	79	8	3	0	0	0	0	90	104	14	0	0.0393701
4190	95%	81	5	0	0	0	0	0	86	91	5	1	0.0393701
4200	94%	54	4	0	0	0	0	0	58	62	4	0	0.0393701
4220	94%	110	6	1	0	0	0	0	117	125	8	0	0.0393701
4230	97%	54	2	0	0	0	0	0	56	58	2	0	0.0393701
4240	77%	58	8	4	2	0	0	0	72	94	22	0	0.0393701
4250	93%	78	6	0	0	0	0	0	84	90	6	0	0.0393701
4260	91%	81	9	0	0	0	0	0	90	99	9	0	0.0393701
4270	95%	78	4	0	0	0	0	0	82	86	4	1	0.0393701
4290	82%	64	8	3	1	0	0	0	76	93	17	0	0.0393701
4300	95%	71	4	0	0	0	0	0	75	79	4	0	0.0393701
4310	95%	78	4	0	0	0	0	0	82	86	4	0	0.0393701
4330	83%	68	6	2	2	0	0	0	78	94	16	0	0.0393701
4340	91%	63	5	1	0	0	0	0	69	76	7	0	0.0393701
4350	87%	53	7	1	0	0	0	0	61	70	9	0	0.0393701
4360	97%	56	2	0	0	0	0	0	58	60	2	0	0.0393701
4470	83%	40	8	1	0	0	0	0	49	59	10	0	0.0393701
4490	90%	40	5	0	0	0	0	0	45	50	5	0	0.0393701
4510	84%	83	14	1	1	0	0	0	99	118	19	0	0.0393701
4520	93%	53	4	0	0	0	0	0	57	61	4	0	0.0393701
4530	77%	45	9	4	0	0	0	0	58	75	17	0	0.0393701
4570	88%	64	10	0	0	0	0	0	74	84	10	0	0.0393701
4710	85%	90	14	1	1	0	0	0	106	125	19	0	0.0393701
4730	80%	65	10	1	1	1	0	0	78	97	19	0	0.0393701
4750	89%	58	6	1	0	0	0	0	65	73	8	0	0.0393701
4770	93%	66	5	0	0	0	0	0	71	76	5	0	0.0393701
4790	90%	51	4	1	0	0	0	0	56	62	6	0	0.0393701
4810	77%	41	13	2	0	0	0	0	56	73	17	0	0.0393701
4820	45%	33	4	1	2	0	1	2	41	91	17	0	0.0393701
4830	83%	53	9	2	0	0	0	0	64	77	13	0	0.0393701
4840	88%	52	8	0	0	0	0	0	60	68	8	0	0.0393701
Total Tips		8485	919	137	25	7	2						