Memo

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

Date: November 7, 2006

To: Kevin Stewart, Chad Kudym

From: Markus Ritsch

Subject: **October 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 October 1 through October 31, 2006.

II. General System Analysis Summary

A total of 193,871 individual data records were analyzed. Meteorological sensors account for 71 percent, water level sensors 12 percent, and rain sensors 7 percent of the total monthly transmissions.

Ninety-eight percent of the received data reports were flagged as "good" by the Nova Star validation process. Roughly 4,742 reports were flagged as "bad". Of these "bad" reports, 3,808 originated from the wind sensor (ID 2189 and 2187) 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 this month was 6,254 reports per day with an average hourly loading of 261 reports. The peak hourly traffic loading was 567 reports, which occurred on October 29th between one and two in the morning. 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. A total of 1,408 rain reports were received from the Hayman gages this month. The Hayman gages were winterized toward the end of October which will skew their reporting statistics this month.

The sensors reporting most frequently this month include:

1. Boulder Creek at Broadway (ID 4583) with 2,926 reports,

2. Squaw Mountain (ID 2189) with 2,891 reports,

3. Marston Lake North (ID 1526) reported 2,826 reports, and

4. Urban Farm (IDs 1464, 1465, 1466, 1467) reported every 15 minutes.

The reports from the above sensors are distributed evenly throughout the month.

III. Rain Sensor Timer Reporting Summary

A total of 171 rain sensors reported during the month. The following analysis assumes that all rain sensors have a 12-hour timer reporting interval. System-wide the ALERT 2 base station received only 80 percent of the non-incrementing timer reports. Those rain sensors with the worst timer reporting statistics are summarized (Table 1).

Table 1. 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	1440	1540/320	330		
1460	1660	4820	1460	1330	4820	1440	1460	1460	1720		
1640	4240	4570	1330	540	4830	110	2340	4820	430		
--	--	--	1610	1600	1600	4820	4820	1440	2270		
			1600	4820	2350	4220		110	2340		

Van Bibber @ Hwy 93 (ID 330), Cherry Cr @ Steele (ID 1720), Utah Park (ID 430), Cub Cr below Blue (ID 2270), El Rancho (ID 2340)

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 its timer performance value is actually better than reported here (see data analysis report for May, 2006).

Beginning in October, the District conducts winterization maintenance activities which will impact the timer performance values.

1. Van Bibber at Hwy 93 (ID 330)

This sensor has a valid count series extending from October 1 through October 27th. Only incrementing count values are present in the series. For some reason, this sensor did not report a 12-hour, non-incrementing timer count value during the month.

2. Cherry Creek at Steele (ID 1720)

This sensor has a valid count series extending from October 1 through October 17th. No reports were received from the sensor after October 17th. It may be that this sensor was winterized on October 17th.

3. Utah Park (ID 430)

This sensor has a valid count series extending from October 1 through October 12th. No reports were received from the sensor after October 12 and it is assumed the station was winterized on October 12th.

4. Cub Creek below Blue (ID 2270)

This sensor has a valid count series extending from October 1 through October 16th. No reports were received from the sensor after October 16 and it is assumed the station was winterized.

5. El Rancho (ID 2340)

This sensor has a valid count series extending from October 1 through October 16th. No reports were received from the sensor after October 16 and it is assumed the station was winterized.

IV. Rain Sensor Event Reporting Summary

A. District-Wide Total Tip/Count Statistics

The incrementing reports from all 1-mm rain sensors (excluding the Hayman gages) were analyzed to quantify the District-wide statistical total monthly tip summary (Table 2).

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

Statistical Parameter	Value	Comments
Mean	41.13	Only the 1-mm rain sensors were included in the analysis
Median	42	Only the 1-mm rain sensors were included in the analysis
Standard deviation	22.27	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	108	Several sensors for the month are outside the Mean +/- 3 Std Dev
Minimum total count	5	Sand Creek Park (ID 1800)
Maximum total count	102	Chatfield COE (ID 1350)

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

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	46.89	24.17	41.13		

The average rainfall experienced district-wide was increased from the prior month of September. The month of October experienced the third highest, district-wide, monthly rainfall total. There were no sensors that experienced a tip count exceeding the system-wide mean plus three standard deviations for the month. The largest sensor accumulation occurred for the rain gage at Chatfield COE (1350). The data record for this sensor was further inspected.

1. Chatfield COE (ID 1350)

Overall the series looks reasonable as several periods of rainfall are evident throughout the month (Figure 1). A second graph is prepared that compares the cumulative count series to that of another gage that also experienced a large accumulation of rainfall, Sensor 4810, Shanahan Ridge (Figure 2).

The count series for both sensors compares favorably. Both sensors respond to the same precipitation events throughout the month. The series for both sensors looks reasonable.
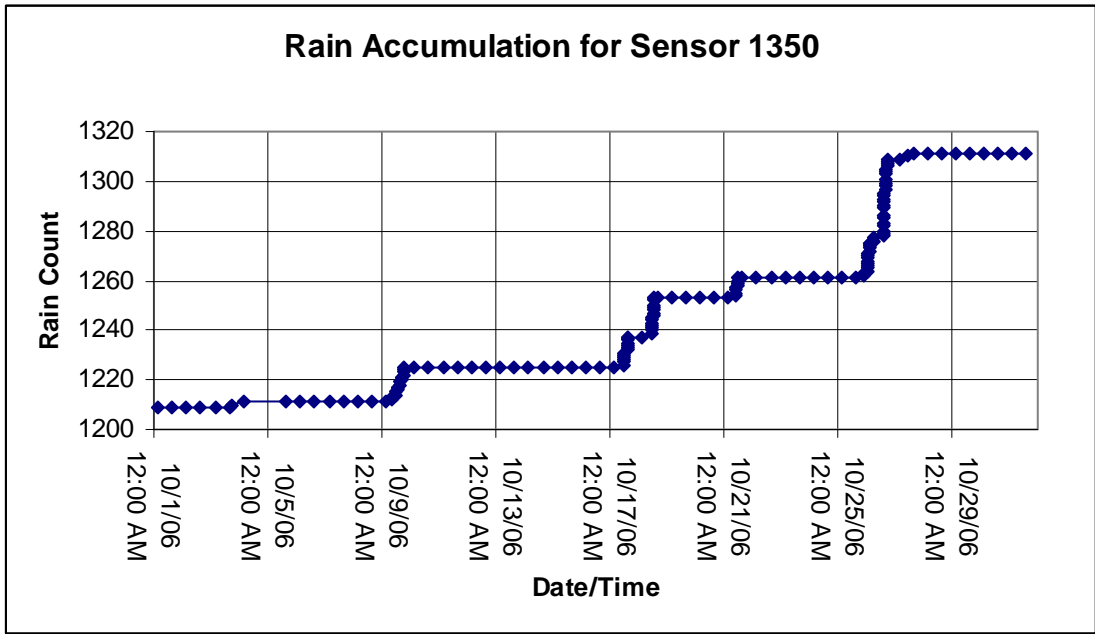
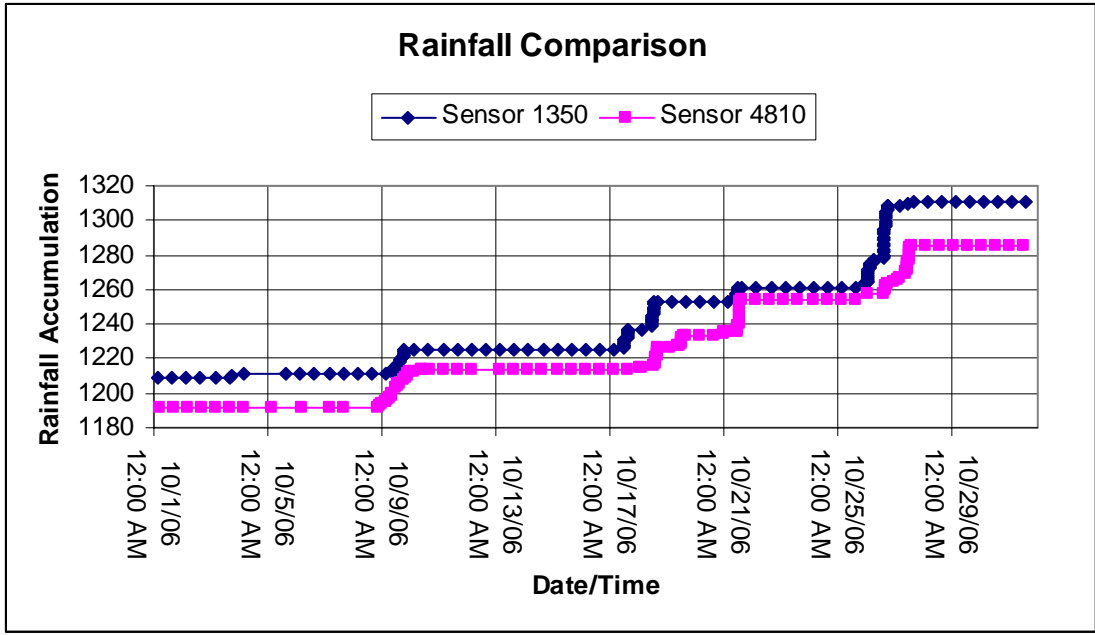**Figure 1. Tip Count Series for Chatfield COE (ID 1350)**

Figure 2. Comparison of Rain Tip Count for Chatfield COE (ID 1350) and Shanahan Ridge (4810)

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

Three rain sensors experienced a jump in their sequential tip count of more than 6. The tip count series for these sensors is explored in the paragraphs below.

1. Diamond Hill (ID 1420)

On October 4th, 5th and 6th, the count series for sensor 1420 was erratic (see below) with several large jumps in count value. It looks like the station was visited on the afternoon of October 6th because it begins to behave normally after 1:30 PM on the 6th.

Sensor ID	Date/Time	Count	Data Type
1420	10/5/2006 1:24:00 PM	2	0
1420	10/5/2006 1:24:54 PM	2	0
1420	10/5/2006 1:27:16 PM	2	0
1420	10/5/2006 1:28:34 PM	2	0
1420	10/5/2006 1:33:57 PM	2	0
1420	10/5/2006 1:54:34 PM	17	0
1420	10/5/2006 1:55:33 PM	17	0
1420	10/5/2006 2:43:24 PM	19	0
1420	10/5/2006 2:44:49 PM	19	0
1420	10/5/2006 3:02:54 PM	19	0
1420	10/5/2006 3:45:59 PM	61	0
1420	10/5/2006 3:48:14 PM	61	0
1420	10/5/2006 3:54:13 PM	61	0

2. Lakeshore (ID 4060)

On October 5th, the rain count jumped from 182 to 192 (see below). This jump was validated by NovaStar. This jump is most likely erroneous because it occurs over a 20 second period. It is possible that field maintenance took place at this time and the field maintenance records should be consulted to see if this was the case.

Sensor ID	Date/Time	Count	Data Type
4060	10/5/2006 1:22:45 AM	181	0
4060	10/5/2006 1:20:47 PM	181	0
4060	10/5/2006 1:56:23 PM	182	0
4060	10/5/2006 1:56:44 PM	192	0
4060	10/5/2006 2:47:53 PM	192	0
4060	10/5/2006 3:07:35 PM	1	0
4060	10/5/2006 3:07:56 PM	2	0

3. Doudy Draw (ID 4820)

A non-incrementing timer transmission was received at 1:09:38 PM on 10/24/06 with a count of 260. The following day, the timer transmission was received at 1:03:46 PM, with a value of 260. The internal clock of this transmitter is drifting considerably and is falling behind by about 6 minutes each day. The timer transmission was received at 12:57:46 PM on 10/26/06 with a count of 264 which was invalidated by NovaStar (see below). The afternoon of October 26th, a number of incrementing rain tip reports are missed by the base station thus causing the large jump of

more than 6 counts at 4:51:51 PM (see below). The tip count series was validated by NovaStar and the rain total at this station looks to be accurate.

Sensor ID	Date/Time	Count	Data Type
4820	10/24/2006 1:09:38 PM	260	0
4820	10/25/2006 1:06:40 AM	260	0
4820	10/25/2006 1:03:46 PM	260	0
4820	10/26/2006 12:57:56 PM	264	1
4820	10/26/2006 1:47:53 PM	262	0
4820	10/26/2006 4:51:51 PM	276	0
4820	10/26/2006 5:06:58 PM	277	0
4820	10/26/2006 5:21:46 PM	278	0
4820	10/26/2006 5:58:20 PM	280	0
4820	10/26/2006 7:10:16 PM	282	0
4820	10/26/2006 8:52:18 PM	283	0
4820	10/26/2006 11:21:52 PM	284	0

C. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing rain tip reports for the month was approximately 93 percent. A total of 5,691 incrementing reports were received and a total of 6,151 were expected. The total loss of incrementing reports for the month was approximately 7.48 percent. Those sensors with the worst rain event transmission characteristics are summarized (Table 4).

Table 4. 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	2370	1200	1720		
1640	4080	4170	310	1400	1350	2350	2310	4820	330		
4490	4170	4820	4820	1100	4790	2310	220	2340	2340		
-----	-----	-----	-----	4820	2340	750	4060	1530	4820		
-----	-----	-----	-----	1420	2350	150	4180	110	4270		

* Van Bibber @ Hwy 93 (330), Doudy Draw (4820), El Rancho (2340), Cherry Cr @ Steele (1720), Cannon Mountain (4270).

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.

Doudy Draw and El Rancho exhibit poor rain event transmission performance for multiple months.

D. Peak Traffic Hour Analysis

The peak hour of radio traffic occurred on 10/29/2006 between 1:00 AM and 2:00 AM. The data for this period was examined more closely to characterize the distribution of sensor transmissions during times of heavy loading (Table 5). During this hour the radio traffic was dominated by wind reports.

Table 5. Peak Traffic Hour Sensor Report Distribution

Sensor Group	Total Reports	Percent
Wind Gust	114	20%
Wind Speed Average & Azimuth	93	16%
Temperature	73	13%
Relative Humidity	72	13%
Wind Direction	49	9%
Water Level PT-HSE	46	8%
Wind Speed Average	34	6%

Precipitation	19	3%
Battery Voltage Digital	12	2%
Battery Voltage HSE	12	2%
Barometric Pressure	9	2%
Solar Radiation	8	1%
Water Level Float	7	1%
Fuel Moisture	4	1%
Fuel Temperature	4	1%
Repeater Pass List	4	1%
Battery Voltage Analog	2	0%
Water Level PT	2	0%
Soil Moisture	2	0%
Precipitation - Test	1	0%
Total	**567**	100%

The accuracy of rain data for the peak hour was further analyzed (Table 6) for the District's 1-mm rain sensors. The Hayman gages are not included in the following analysis. No single incrementing tip reports were lost during this peak hour. The rainfall accumulation totals as tracked by NovaStar for the peak hour were accurate. There were no sensors that under-reported rainfall due to the loss of sequential tip counts.

Table 6. Peak Traffic Hour Rain Reporting Summary – Annual Reporting

Heavy Traffic Period	Traffic Msgs/hr	Rain reports expected	Rain reports received	Loss of reports	Accurate rain totals
10/29/06 1:00 AM – 2:00 AM	567	19	19	0.00%	Yes
9/21/06 3:00 AM – 4:00 AM	620	117	114	2.56%	Yes
8/13/06 9:00 PM – 10:00 PM	1,107	346	286	17.34%	Yes

The table above will be used to track the peak hour summary for each month so that over a period of time a correlation can be developed between peak hour loading and loss of single increment reports.

V. Issues Continued from Previous Month

The following issues were identified last month.

1. Doudy Draw (ID 4820) and El Rancho (ID 2340) exhibit poor timer and event transmission performance.

VI. Issues Identified this Month

Further investigation into the following issues is recommended:

1. Van Bibber @ Hwy 93 (ID 330) had both poor timer and event performance characteristics for the month of October. This sensor has an incrementing rain count series extending from October 1 through October 30. Only incrementing count values are present in the series. For some reason, this sensor did not report a 12-hour, non-incrementing timer count value.

2. Diamond Hill Complex rain sensor (ID 1420) had erratic raw count values on October 4th, 5th, and 6th. The tip series included values that were erroneously validated. Quality control should be performed on the historic/archival data series for this sensor to ensure accurate rain totals are available for future analyses.

3. Lakeshore rain sensor (ID 4060) had a jump in raw count from 182 to 192 on October 5th. The tip series included values that were erroneously validated. Quality control should be performed on the historic/archival series for this sensor to ensure accurate rain totals are available for use of the data in further analyses.

4. Doudy Draw and El Rancho exhibit poor rain event transmission performance for multiple months.

General System Analysis

Database Name	P:\A207-UDFCD-Data-Analysis\2006_Oct\Novastar_extract_2006Oct.mdb		
First Date in Database	10/1/06 12:00 AM	**Total Days**	31.0
Last Date in Database	10/31/06 11:59 PM	**Total Hours**	744.0
Total Records Analyzed	193871		

Records by Group

Wind Gust	34482	18%
Relative Humidity	26476	14%
Temperature	25029	13%
Water Level PT-HSE	17868	9%
Wind Direction	17045	9%
Wind Speed Average & Azimuth	16866	9%
Precipitation	14033	7%
Wind Speed Average	11319	6%
Battery Voltage HSE	5460	3%
Battery Voltage Digital	4495	2%
Solar Radiation	3910	2%
Water Level PT	2965	2%
Water Level Float	2937	2%
Barometric Pressure	2244	1%
Precipitation - Mean	1585	1%
Fuel Moisture	1476	1%
Fuel Temperature	1471	1%
Hayman Precipitation	1408	1%
Repeater Pass List	974	1%
Handar 585 ALARM Status	607	0%
Battery Voltage Analog	502	0%
Precipitation - Test	247	0%
12Hr Status Report	213	0%
Longmont Flow Gage	117	0%
Soil Moisture	83	0%
Longmont Water Level PT	56	0%
Solar Power	3	0%
Total	193871	

Records by Major Group

Meteorologic Sensors	137371	71%
Water Level Sensors	23943	12%
Rain Sensors	14033	7%
Sensor Status Transmissions	12254	6%
Soil and Fuel Sensors	3030	2%
Total	190631	

Records by Validation Type

Good	0	189129	98%
Questionable	1	4742	2%
	Total	193871	

Sensors With Most Invalid Data

Description	Sensor	Reports
Squaw Mountain	2189	2889
Squaw Mountain	2187	919
Blue Mountain	139	163
Elbert	1439	82
Quincy Reservoir	753	45

Traffic Loading Summary

Alert Reports	193871	
Average Daily Traffic	6254	
Average Hourly Traffic	261	
Median Hourly Traffic	255	hour beginning
Peak Hourly Traffic	567	10/29/06 1:00 AM

Total Number of Sensors Defined	**Total Number of Sensors Reporting**
806	534

Reports per Sensor

Description	Sensor	Reports	Fraction of Total
Boulder Cr at Broadway	4583	2926	2%
Squaw Mountain	2189	2891	1%
Marston Lake North	1526	2826	1%
Urban Farm	1466	2821	1%
Green Ditch	4593	2809	1%
Urban Farm	1465	2800	1%
Marston Lake North	1521	2799	1%
Urban Farm	1464	2786	1%
Urban Farm	1467	2757	1%
Ward C-1	4707	2723	1%
Salisbury Park	2727	2717	1%
Castle Rock	2744	2694	1%
Salisbury Park	2724	2588	1%
Elbert	1439	2582	1%
Hiwan G.C.	2208	2574	1%

Rain Timer Performance

Rain Sensors	Description	Received Timer Reports	systemwide average (days) 0.5183 Average Timer Interval	Expected Timer Reports	Systemwide Average 80% Performance
100	Carr Street	36	12:45	62.00	58%
110	Ralston Reservoir	54	12:29	62.00	87%
120	West Woods	56	12:12	62.00	90%
140	Blue Mountain	57	12:42	62.00	92%
150	Nott Creek	57	12:46	62.00	92%
200	Leyden Reservoir	56	12:12	62.00	90%
210	Leyden Confluence	34	13:40	62.00	55%
220	Upper Leyden	56	12:45	62.00	90%
300	Van Bibber Park	60	11:56	62.00	97%
310	Guy Hill Ranch	39	13:05	62.00	63%
320	Sports Complex	35	12:22	62.00	56%
330	Van Bibber @ Hwy 93	1		62.00	
400	Montview Park	32	11:58	62.00	52%
410	Kelly Dam	55	12:43	62.00	89%
420	Expo Park	32	11:57	62.00	52%
430	Utah Park	20	12:48	62.00	32%
440	Fire Station #7	61	12:11	62.00	98%
500	Havana Park	31	11:57	62.00	50%
510	Virginia Court	58	12:13	62.00	94%
520	Jewell Detention	58	12:27	62.00	94%
530	Fire Station #19	61	11:56	62.00	98%
540	Parker/Mississippi	43	14:55	62.00	69%
600	Harvard Gulch Park	55	12:43	62.00	89%
610	Harvard @ Jackson	32	12:50	62.00	52%
620	Quincy/Highline	56	12:31	62.00	90%
630	Temple Pond at DTC	56	12:07	62.00	90%
640	Goldsmith @ Eastman	58	11:50	62.00	94%
650	Iliff Pond	33	12:22	62.00	53%
700	Toll Gate @ 6th	59	12:13	62.00	95%
710	Horseshoe Park Drop	37	11:47	62.00	60%
720	Confluence Pond	36	12:16	62.00	58%
730	No Name @ Quincy	36	12:22	62.00	58%
740	Smoky Hill	60	12:26	62.00	97%
750	Quincy Reservoir	54	13:18	62.00	87%
760	Mission Viejo Park	60	11:56	62.00	97%
800	Sable Ditch @ 18th	36	12:20	62.00	58%
810	Granby Ditch @ 6th	32	12:49	62.00	52%
820	ETG @ Buckley	33	12:22	62.00	53%
830	Side Creek Park	59	12:26	62.00	95%
840	Fire Station 12	56	12:14	62.00	90%
850	Flying J	34	12:38	62.00	55%
860	Sand Cr at Colfax	27	15:30	62.00	44%
870	Murphy Creek GC	36	12:00	62.00	58%
900	Aurora Reservoir	59	12:27	62.00	95%
1000	Maple Grove Resv.	53	13:23	62.00	85%
1010	Denver West	57	12:45	62.00	92%
1020	Lena @ Nolte Pond	35	12:42	62.00	56%
1030	NREL/S. Table Mtn.	56	12:46	62.00	90%
1040	Lena @ U.S. Hwy 6	34	12:53	62.00	55%
1050	Jeffco Fairgrounds	57	12:27	62.00	92%
1060	Heritage Square	59	12:26	62.00	95%
1100	Louisville Rec Ctr	55	13:28	62.00	89%
1110	Gunbarrel	50	12:51	62.00	81%
1200	Broomfield 3207	34	12:22	62.00	55%
1300	Hidden Lake	54	12:44	62.00	87%
1310	LDC at 64th	55	12:44	62.00	89%
1320	SPR at 3rd Ave	56	12:36	62.00	90%
1330	Roslyn	61	11:58	62.00	98%
1340	Sanderson at Xavier	58	12:14	62.00	94%
1350	Chatfield COE	55	11:58	62.00	89%
1360	Denver Zoo	58	12:14	62.00	94%
1370	West Metro FS13	58	12:13	62.00	94%
1400	Upper Sloan Det.	33	12:49	62.00	53%
1420	Diamond Hill	91	7:42	62.00	147%
1440	Elbert	60	12:12	62.00	97%
1460	Urban Farm	29	1:05	62.00	47%
1480	Third Creek at DIA	61	12:12	62.00	98%
1500	Powers Park	56	12:50	62.00	90%
1520	Marston Lake North	58	12:31	62.00	94%
1530	Bear Creek @ Lowell	55	13:02	62.00	89%
1540	Sanderson at Xavier	60	12:11	62.00	97%
1600	Englewood Dam	56	12:57	62.00	90%
1610	Holly Dam	62	11:57	62.00	100%

1620	Slaughterhouse Glch	56	13:00	62.00	90%
1640	SPR at Union Ave.	52	14:19	62.00	84%
1660	SPR at Henderson	58	12:27	62.00	94%
1700	Cherry Cr @ Champa	55	12:46	62.00	89%
1710	Shop Creek	34	19:09	62.00	55%
1720	Cherry Cr @ Steele	10	12:00	62.00	16%
1800	Sand Creek Park	32	11:50	62.00	52%
1810	Sand Creek at mouth	57	11:58	62.00	92%
1900	Niver Detention	60	12:10	62.00	97%
1920	Brighton	59	11:58	62.00	95%
2190	Squaw Mountain	55	12:56	62.00	89%
2210	Hiwan G.C.	66	11:00	62.00	106%
2220	Evergreen Lake	63	11:45	62.00	102%
2230	Bear Cr below Cub	32	11:33	62.00	52%
2240	Cold Sprg Glch conf	36	12:00	62.00	58%
2250	Rosedale	29	10:54	62.00	47%
2260	Brook Forest	31	12:00	62.00	50%
2270	Cub Cr below Blue	26	12:00	62.00	42%
2280	Kinney Peak	32	11:41	62.00	52%
2310	Genesee Village	32	11:32	62.00	52%
2330	Morrison	56	11:56	62.00	90%
2340	El Rancho	27	12:29	62.00	44%
2350	Idledale	35	12:00	62.00	56%
2360	Indian Hills	31	11:36	62.00	50%
2370	Red Rocks Park	33	12:00	62.00	53%
2710	Highlands Ranch WTP	59	11:58	62.00	95%
2730	Salisbury Park	56	12:14	62.00	90%
2750	Castle Rock	58	12:14	62.00	94%
2810	Pine Cliff Road	53	12:52	62.00	85%
2820	Haskins Gulch Conf	56	12:30	62.00	90%
2840	Sulphur Gulch	57	12:40	62.00	92%
4010	Cresent	57	12:14	62.00	92%
4020	Rio Grande	59	11:56	62.00	95%
4030	Red Garden	57	12:43	62.00	92%
4040	Martin Gulch	62	11:57	62.00	100%
4050	Walker Ranch	59	12:45	62.00	95%
4060	Lakeshore	51	13:25	62.00	82%
4070	Bear Peak	62	11:56	62.00	100%
4080	Twin Sisters	44	12:18	62.00	71%
4090	Magnolia	51	13:05	62.00	82%
4100	Filter Plant	55	13:21	62.00	89%
4110	Betasso	57	12:32	62.00	92%
4130	Swiss Peaks	52	13:42	62.00	84%
4140	Logan Mill	55	12:14	62.00	89%
4150	Gold Hill	57	12:22	62.00	92%
4160	Sunshine	62	11:39	62.00	100%
4170	Pine Brook	49	14:01	62.00	79%
4180	Gold Lake	52	12:53	62.00	84%
4190	Slaughterhouse	56	12:35	62.00	90%
4200	Lazy Acres	59	12:28	62.00	95%
4220	Fling's	56	12:46	62.00	90%
4230	Golden Age	57	12:27	62.00	92%
4240	Sunset	56	12:31	62.00	90%
4250	Geer Canyon	57	12:13	62.00	92%
4260	Taylor Mountain	61	11:54	62.00	98%
4270	Cannon Mountain	52	12:13	62.00	84%
4290	Red Hill	60	11:55	62.00	97%
4300	Big Elk Park	60	12:23	62.00	97%
4310	Johnny Park	59	11:57	62.00	95%
4330	Indian Ruins	61	11:40	62.00	98%
4340	Riverside	58	12:30	62.00	94%
4350	Conifer Hill	58	12:00	62.00	94%
4360	Justice Center	58	12:28	62.00	94%
4470	Little Narrows	50	14:08	62.00	81%
4490	Apple Valley	57	12:27	62.00	92%
4510	Pinewood Springs	55	12:49	62.00	89%
4520	Eagle Ridge	56	13:01	62.00	90%
4530	Winiger Ridge	60	12:11	62.00	97%
4560	Lyons Diversion NSV	49	14:28	62.00	79%
4570	St. Antons	54	13:20	62.00	87%
4710	Ward C-1	58	11:59	62.00	94%
4730	Sugarloaf	59	12:14	62.00	95%
4750	Louisville Lake	55	13:02	62.00	89%
4770	Cal-Wood Ranch	58	12:14	62.00	94%
4790	Button Rock	57	12:32	62.00	92%
4810	Shanahan Ridge	50	13:08	62.00	81%
4820	Doudy Draw	46	13:46	62.00	74%
4830	SBC @ San Souci	51	13:06	62.00	82%
4840	SBC@S Boulder Ditch	56	12:27	62.00	90%

Rain Event Performance

		Reports Receiv	5691		Analyze Rain Sensors								
	Systemwide Avg	Total Tips	6151										
	93%	Data Loss	7.48%										

Rain Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Received	Expected	Missed	Hold-off	Bucket
100	96%	23	1	0	0	0	0	0	24	25	1	0	0.0393701
110	86%	36	7	0	0	0	0	0	43	50	7	0	0.0393701
120	94%	63	4	0	0	0	0	0	67	71	4	0	0.0393701
140	100%	21	0	0	0	0	0	0	21	21	0	0	0.0393701
150	93%	38	3	0	0	0	0	0	41	44	3	0	0.0393701
200	96%	63	3	0	0	0	0	0	66	69	3	0	0.0393701
210	92%	21	0	1	0	0	0	0	22	24	2	0	0.0393701
220	93%	53	4	0	0	0	0	0	57	61	4	0	0.0393701
300	98%	53	1	0	0	0	0	0	54	55	1	0	0.0393701
310	83%	13	1	1	0	0	0	0	15	18	3	0	0.0393701
320	96%	25	1	0	0	0	0	0	26	27	1	0	0.0393701
330	69%	37	24	2	0	0	0	0	63	91	28	0	0.0393701
400	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
410	98%	38	1	0	0	0	0	0	39	40	1	0	0.0393701
420	94%	27	2	0	0	0	0	0	29	31	2	0	0.0393701
430	85%	9	2	0	0	0	0	0	11	13	2	0	0.0393701
440	90%	34	2	1	0	0	0	0	37	41	4	0	0.0393701
500	94%	14	1	0	0	0	0	0	15	16	1	0	0.0393701
510	98%	49	1	0	0	0	0	0	50	51	1	0	0.0393701
520	85%	24	3	1	0	0	0	0	28	33	5	0	0.0393701
530	90%	42	5	0	0	0	0	0	47	52	5	0	0.0393701
540	83%	35	7	1	0	0	0	0	43	52	9	0	0.0393701
600	98%	49	1	0	0	0	0	0	50	51	1	0	0.0393701
610	95%	18	1	0	0	0	0	0	19	20	1	0	0.0393701
620	96%	45	2	0	0	0	0	0	47	49	2	0	0.0393701
630	92%	55	3	1	0	0	0	0	59	64	5	0	0.0393701
640	100%	46	0	0	0	0	0	0	46	46	0	0	0.0393701
650	84%	14	1	1	0	0	0	0	16	19	3	0	0.0393701
700	89%	30	2	1	0	0	0	0	33	37	4	0	0.0393701
710	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
720	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
730	100%	9	0	0	0	0	0	0	9	9	0	0	0.0393701
740	100%	14	0	0	0	0	0	0	14	14	0	0	0.0393701
750	95%	20	1	0	0	0	0	0	21	22	1	0	0.0393701
760	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701
800	88%	6	1	0	0	0	0	0	7	8	1	0	0.0393701
810	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
820	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
830	100%	25	0	0	0	0	0	0	25	25	0	0	0.0393701
840	84%	27	4	1	0	0	0	0	32	38	6	0	0.0393701
850	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
860	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
870	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
900	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393699
1000	94%	68	5	0	0	0	0	0	73	78	5	0	0.0393701
1010	91%	48	5	0	0	0	0	0	53	58	5	0	0.0393701
1030	93%	41	1	1	0	0	0	0	43	46	3	0	0.0393701
1040	97%	28	1	0	0	0	0	0	29	30	1	0	0.0393701
1050	98%	39	1	0	0	0	0	0	40	41	1	0	0.0393701
1060	100%	33	0	0	0	0	0	0	33	33	0	0	0.0393701
1100	88%	51	6	1	0	0	0	0	58	66	8	0	0.0393701
1110	94%	49	1	1	0	0	0	0	51	54	3	0	0.0393701
1200	90%	16	2	0	0	0	0	0	18	20	2	0	0.0393701
1300	98%	49	1	0	0	0	0	0	50	51	1	0	0.0393701
1310	87%	40	4	0	1	0	0	0	45	52	7	0	0.0393701
1320	97%	57	2	0	0	0	0	0	59	61	2	0	0.0393701
1330	98%	45	1	0	0	0	0	0	46	47	1	0	0.0393701
1340	82%	51	7	0	2	0	0	0	60	73	13	0	0.0393701
1350	88%	82	7	0	0	0	1	0	90	102	12	0	0.0393701
1360	97%	55	2	0	0	0	0	0	57	59	2	0	0.0393701
1370	98%	51	1	0	0	0	0	0	52	53	1	0	0.0393701
1400	96%	21	1	0	0	0	0	0	22	23	1	0	0.0393701
1420	91%	62	3	2	0	0	0	0	67	74	7	0	0.0393701
1440	100%	15	0	0	0	0	0	0	15	15	0	0	0.0393701
1460	98%	40	1	0	0	0	0	0	41	42	1	0	0.0393701
1480	96%	25	1	0	0	0	0	0	26	27	1	0	0.0393701
1500	95%	58	3	0	0	0	0	0	61	64	3	0	0.0393701
1520	95%	52	3	0	0	0	0	0	55	58	3	0	0.0393701
1530	87%	51	7	1	0	0	0	0	59	68	9	0	0.0393701
1540	93%	52	4	0	0	0	0	0	56	60	4	0	0.0393701
1545	70%	4	3	0	0	0	0	0	7	10	3	0	0.0393701
1600	96%	26	1	0	0	0	0	0	27	28	1	0	0.0393701
1620	83%	32	6	1	0	0	0	0	39	47	8	0	0.0393701
1640	88%	40	6	0	0	0	0	0	46	52	6	0	0.0393701
1660	94%	29	2	0	0	0	0	0	31	33	2	0	0.0393701
1700	95%	36	2	0	0	0	0	0	38	40	2	0	0.0393701
1710	93%	25	2	0	0	0	0	0	27	29	2	0	0.0393701
1720	60%	6	2	0	0	1	0	0	9	15	6	0	0.0393701
1800	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
1810	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701
1900	97%	27	1	0	0	0	0	0	28	29	1	0	0.0393701
1920	93%	34	3	0	0	0	0	0	37	40	3	0	0.0393701
2190	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
2210	100%	39	0	0	0	0	0	0	39	39	0	1	0.0393701
2230	100%	9	0	0	0	0	0	0	9	9	0	1	0.0393701
2240	100%	17	0	0	0	0	0	0	17	17	0	0	0.0393701
2250	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
2260	87%	12	0	1	0	0	0	0	13	15	2	0	0.0393701
2270	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
2280	93%	12	1	0	0	0	0	0	13	14	1	1	0.0393701
2310	92%	10	1	0	0	0	0	0	11	12	1	0	0.0393701
2320	93%	40	3	0	0	0	0	0	43	46	3	0	0.0393701
2330	92%	55	3	1	0	0	0	0	59	64	5	0	0.0393701
2340	75%	4	2	0	0	0	0	0	6	8	2	0	0.0393701
2350	89%	14	2	0	0	0	0	0	16	18	2	1	0.0393701
2360	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701
2370	100%	26	0	0	0	0	0	0	26	26	0	0	0.0393701
2710	98%	44	1	0	0	0	0	0	45	46	1	0	0.0393701
2730	100%	11	0	0	0	0	0	0	11	11	0	0	0.0393701
2750	100%	18	0	0	0	0	0	0	18	18	0	0	0.0393701
2810	88%	33	5	0	0	0	0	0	38	43	5	0	0.0393701

2820	95%	35	2	0	0	0	0	0	37	39	2	0	0.0393701
2840	96%	24	1	0	0	0	0	0	25	26	1	0	0.0393701
4010	88%	33	3	1	0	0	0	0	37	42	5	0	0.0393701
4020	98%	44	1	0	0	0	0	0	45	46	1	0	0.0393701
4030	92%	55	5	0	0	0	0	0	60	65	5	0	0.0393701
4040	92%	65	6	0	0	0	0	0	71	77	6	0	0.0393701
4050	98%	42	1	0	0	0	0	0	43	44	1	0	0.0393701
4060	83%	35	7	1	0	0	0	1	43	52	9	0	0.0393701
4070	94%	44	3	0	0	0	0	0	47	50	3	0	0.0393701
4080	86%	15	3	0	0	0	0	0	18	21	3	0	0.0393701
4090	93%	36	3	0	0	0	0	0	39	42	3	0	0.0393701
4100	98%	47	1	0	0	0	0	0	48	49	1	0	0.0393701
4110	96%	67	3	0	0	0	0	0	70	73	3	0	0.0393701
4130	93%	40	1	1	0	0	0	0	42	45	3	0	0.0393701
4140	89%	51	5	1	0	0	0	0	57	64	7	0	0.0393701
4150	90%	48	6	0	0	0	0	0	54	60	6	0	0.0393701
4160	100%	65	0	0	0	0	0	0	65	65	0	0	0.0393701
4170	95%	51	3	0	0	0	0	0	54	57	3	0	0.0393701
4180	92%	30	3	0	0	0	0	0	33	36	3	0	0.0393701
4190	97%	56	2	0	0	0	0	0	58	60	2	0	0.0393701
4200	98%	60	1	0	0	0	0	0	61	62	1	0	0.0393701
4220	94%	28	2	0	0	0	0	0	30	32	2	0	0.0393701
4230	100%	30	0	0	0	0	0	0	30	30	0	0	0.0393701
4240	93%	25	2	0	0	0	0	0	27	29	2	0	0.0393701
4250	98%	79	2	0	0	0	0	0	81	83	2	0	0.0393701
4260	100%	29	0	0	0	0	0	0	29	29	0	0	0.0393701
4270	78%	23	5	0	1	0	0	0	29	37	8	0	0.0393701
4290	97%	68	2	0	0	0	0	0	70	72	2	0	0.0393701
4300	98%	39	1	0	0	0	0	0	40	41	1	0	0.0393701
4310	95%	59	3	0	0	0	0	0	62	65	3	0	0.0393701
4330	96%	52	2	0	0	0	0	0	54	56	2	0	0.0393701
4340	100%	47	0	0	0	0	0	0	47	47	0	0	0.0393701
4350	96%	48	2	0	0	0	0	0	50	52	2	0	0.0393701
4360	99%	86	1	0	0	0	0	0	87	88	1	0	0.0393701
4470	89%	56	6	1	0	0	0	0	63	71	8	0	0.0393701
4490	92%	45	4	0	0	0	0	0	49	53	4	0	0.0393701
4510	84%	41	10	0	0	0	0	0	51	61	10	0	0.0393701
4520	98%	45	1	0	0	0	0	0	46	47	1	0	0.0393701
4530	88%	38	6	0	0	0	0	0	44	50	6	0	0.0393701
4570	95%	34	2	0	0	0	0	0	36	38	2	0	0.0393701
4710	93%	25	2	0	0	0	0	0	27	29	2	0	0.0393701
4730	88%	18	3	0	0	0	0	0	21	24	3	0	0.0393701
4750	89%	48	5	1	0	0	0	0	54	61	7	0	0.0393701
4770	93%	39	3	0	0	0	0	0	42	45	3	0	0.0393701
4790	82%	40	3	2	1	0	0	0	46	56	10	0	0.0393701
4810	87%	73	6	3	0	0	0	0	82	94	12	0	0.0393701
4820	77%	35	9	1	1	0	0	1	46	60	14	0	0.0393701
4830	84%	56	7	3	0	0	0	0	66	79	13	0	0.0393701
4840	94%	74	5	0	0	0	0	0	79	84	5	0	0.0393701
	Total Tips	5285	363	35	6	1	1	2	5691	6151			

Bucket Tip Data Analysis

Mean	41.12667
Median	42
Std Deviation	22.27175
Mean + 3 st dev	107.9419
Mean - 3 st dev	-25.68858
Min	5
Max	102