

Memo

Date: December 4, 2012
To: Kevin Stewart
From: Markus Ritsch
Subject: November 2012 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 November 1 through November 30, 2012.

II. General System Analysis Summary

A total of 335,603 legacy ALERT data reports were analyzed. Meteorological sensors account for 50 percent, water level sensors 3 percent, and rain sensors 2 percent of the total monthly records.

The system-wide radio traffic loading was 11,187 reports per day with an average hourly loading of 466 reports. The peak hour of radio traffic loading was 929 reports, which occurred on November 4th, between 1:00 AM and 2:00 AM. A plot of monthly average and peak hourly traffic loading is provided.

A. Specific Issues Identified this Month

Performance of the following sensors (Table 1) was questionable this month.

Table 1. Rain Sensors with Poor Performance Characteristics

Rain ID	Description	Timer	Event	Comments
3070	Newlin Gulch	92	25	
4270	Cannon Mountain	77	100	
4290	Red Hill	95	75	
4310	Johnny Park	78	100	
4330	Hansen Rain	88	100	
4490	Apple Valley	85	100	
4550	Boulder Jail	N/A	N/A	Zero reports recorded this month
4850	Porphory Mtn	27	100	
4870	SBC @ SB Road	75	100	
112, 116, 118	Ralston Res (Site 110) is sending reports on undefined sensors IDs			
2734 and 2733	Salisbury Park (site 2730) is sending data on undefined ID			

B. Continuous Operation of Base Receiver/Decoder

The ALERT and ALERT2 data feeds on the NS5 base station computer were in continuous operation for the entire month.

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 2).

Table 2. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
2320	4550	4270	2890	1710	1660	1660	2270	1640	4850	4850	
1460	1460	4870	1640	2230	2950	2790	2320	2900	4310	4870	
1520	4470	4790	2270	4870	540	4330	3090	2270	4550	4270	
1440	1520	4850	2970	1900	1710	2270	4330	2190	4490	4310	
1000	1440	4570	4490	1660	4330	2320	870	2320	4870	4510	
4520	140	4070	3010	4330	2320	4870	4270	1660	4290	2790	

*- 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 3). 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 3. District-Wide Total Tip/Count Statistical Summary

Statistical Parameter	Value	Comments
Mean	2.98	Only the 1-mm rain sensors were included in the analysis
Median	2.5	Only the 1-mm rain sensors were included in the analysis
Standard deviation	2.34	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	10.01	Only the 1-mm rain sensors were included in the analysis
Minimum total count	1	Numerous stations
Maximum total count	11	Diamond Hill (ID1420)

B. Monthly Average Tip/Count Summary

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

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		

*- 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 5).

Table 5. Sensors with a Jump of 6 or More in Sequential Count

Sensor Description	Sensor ID	Comment
		No sensors identified this month

D. Sensor-by-Sensor Incrementing Count Summary

The system-wide reception rate of incrementing, 1-mm tip reports for the month was approximately 94 percent. A total of 152 incrementing reports were received and a total of 161 reports were expected. The total loss of incrementing reports for the month was approximately 6 percent. Those sensors with the worst event transmission performance are summarized (Table 6).

Table 6. Monthly Summary of Sensors with the Most Missed Tips

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
1700	2980	2710	4490	2270	700	3070	3070	3070	4490	3070	
1420	3030	4860	2980	4870	2970	4470	4790	110	4330	4290	
4490	4240	2930	1660	4470	3070	4330	2860	2980	4290	1420	
2980	1520	3030	3010	2980	400	2980	4490	310	4470	1460	
1660	4490	2990	2320	310	2730	4870	2980	4490	4870	2990	
4090	1420	4050	4470	2280	4330	2870	620	2790	4730	4730	

*-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 7). Each hour exceeding 1,000 reports was analyzed to quantify the number of missing rain reports for that hour.

Table 7. Periods of Heavy Radio Traffic

Day	Hour	Expected	Received	Total Load	Loss
4	1	13	13	929	0.00 %
10	13	14	14	710	0.00 %
10	12	19	19	696	0.00 %
11	13	1	1	644	0.00 %
10	14	2	2	643	0.00 %
11	14	1	1	632	0.00 %
10	11	1	1	600	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 8).

Table 8. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	295
Total reports from unknown IDs	3,854
Unknown IDs with only a single received report (potential noise)	165
Total reports from all IDs – RecData Log entire month	335,603
Unknown reports as a fraction of total reports	1.15%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 9) are the total reports received from unknown sensor IDs for each month of the year.

Table 9. 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	

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 10).

Table 10. 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%	

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 11).

Table 11. Reports Received by Unknown IDs

Unknown ID	Reports
2734	2,866
2733	205
112	14
118	14
116	14
1529	18
1423	17
1446	16
1934	15

General System Analysis

Database Name

P:\A207-UDFCD-Data-Analysis\2012\11-2012\Novastar_extract_2012Nov.mdb

First Date in Database

11/1/12 12:00 AM

Total Days

30.0

Last Date in Database

11/30/12 11:59 PM

Total Hours

720.0

Total Records Analyzed

335,603

Records by Group

Wind Data	119,268	36%
Temperature	66,768	20%
Relative Humidity	57,551	17%
Barometric Pressure	31,998	10%
Battery Voltage	11,666	3%
Solar Radiation	10,160	3%
Water Level	9,856	3%
Precipitation	6,345	2%
Fuel Moisture	5,536	2%
Fuel Temperature	5,527	2%
Unknown	3,854	1%
Soil Moisture	2,639	1%
Repeater Status Report	2,352	1%
Flasher Status	1,167	0%
Repeater Pass List	588	0%
12Hr Status Report	315	0%
Solar Power	9	0%
Handar 585 ALARM Status	3	0%
Dewpoint Temperature	1	0%
Total	335,603	

Records by Major Group

Meteorologic Sensors	166,477	50%
Soil and Fuel Sensors	13,702	4%
Water Level Sensors	9,856	3%
Rain Sensors	6,345	2%
Sensor Status Transmissions	3,267	1%
Total	199,647	

Traffic Loading Summary

Alert Reports	335,603	
Average Daily Traffic	11,187	
Average Hourly Traffic	466	
Median Hourly Traffic	465	hour beginning
Peak Hourly Traffic	929	Nov 4, 1:00 AM
2nd Max	710	Nov 10, 1:00 PM
3rd Max	696	Nov 10, 12:00 PM
4th Max	644	Nov 11, 1:00 PM
5th Max	643	Nov 10, 2:00 PM

Rain Timer Performance

Analyze Rain Sensors

Rain Sensors	Description	Rcv	Timer	Exp	Performance
4850	Porphory Mtn	16	4:00	60	27%
4870	SBC @ SB Road	45	15:07	60	75%
4270	Cannon Mountain	46	15:12	60	77%
4310	Johnny Park	47	11:58	60	78%
4510	Pinewood Springs	51	13:39	60	85%
4490	Apple Valley	51	14:06	60	85%
2790	W. Cherry Creek Wx	51	13:41	60	85%
2730	Wx-Salisbury Park	53	13:10	60	88%
4470	Little Narrows	53	13:23	60	88%
4330	Hansen Rain	53	12:54	60	88%
920	Wx-Aurora Town Hall	55	13:06	60	92%
3070	Newlin Gulch	55	12:12	60	92%
4790	Wx-Button Rock	56	12:38	60	93%
4020	Rio Grande	56	12:23	60	93%
3010	EPC at Hwy 105	56	12:25	60	93%
4290	Red Hill	57	12:23	60	95%
4100	Filter Plant	57	12:24	60	95%
4060	Lakeshore	57	12:23	60	95%
4010	Crescent	57	12:23	60	95%
1460	Wx-Urban Farm	58	12:12	60	97%
2710	Wx-Highlands Ranch WTF	58	12:12	60	97%
4770	Wx-Cal-Wood Ranch	58	12:11	60	97%
4570	St. Antons	58	12:11	60	97%
4360	Justice Center	58	12:01	60	97%
4340	Riverside	58	12:22	60	97%
4240	Sunset	58	12:09	60	97%
4200	Lazy Acres	58	12:11	60	97%
4190	Slaughterhouse	58	12:22	60	97%
4180	Gold Lake	58	12:09	60	97%
4150	Gold Hill	58	12:10	60	97%
4110	Betasso	58	12:11	60	97%
3020	Wx-West Creek WX	59	11:59	60	98%
4710	Wx-Ward C-1	59	11:58	60	98%
2990	Wx-Tomah Rd-DougCnty	59	11:46	60	98%
4730	Wx-Sugarloaf	59	11:58	60	98%
4750	Wx-Louisville Lake	59	11:58	60	98%
2210	Wx-Hiwan G.C.	59	11:59	60	98%
2750	Wx-Castle Rock	59	11:58	60	98%
4530	Winiger Ridge	59	12:09	60	98%
4860	Fairview Peak	59	11:59	60	98%
4840	SBC@S Boulder Ditch	59	12:10	60	98%
4830	SBC @ San Souci	59	12:09	60	98%
4820	Doudy Draw	59	12:09	60	98%
4350	Conifer Hill	59	11:57	60	98%
4300	Big Elk Park	59	11:56	60	98%
4260	Taylor Mountain	59	11:57	60	98%
4250	Geer Canyon	59	11:57	60	98%
4220	Fling's	59	11:56	60	98%
4170	Pine Brook	59	11:58	60	98%
4160	Sunshine	59	11:57	60	98%
4130	Swiss Peaks	59	11:58	60	98%
4090	Magnolia	59	11:57	60	98%
4080	Twin Sisters	59	11:57	60	98%
4070	Bear Peak	59	11:56	60	98%

4040	Martin Gulch	59	12:09	60	98%
4030	Red Garden	59	11:58	60	98%
2980	Dakan Rd	59	12:11	60	98%
2930	Spring Valley Rd-DougC	60	11:46	60	100%
1440	Wx-Elbert	60	11:53	60	100%
1920	Wx-Brighton	60	11:58	60	100%
140	Wx-Blue Mountain	60	11:52	60	100%
3030	WX-Bingham Lake Park	60	11:58	60	100%
4880	Whispering Pines	60	11:44	60	100%
4520	Eagle Ridge	60	11:58	60	100%
4230	Golden Age	60	11:32	60	100%
4140	Logan Mill	60	11:56	60	100%
4050	Walker Ranch	60	11:57	60	100%
4320	Lee Hill Rain 2012	61	11:44	60	102%
750	Wx-Quincy Reservoir	62	11:20	60	103%
1570	Wx-Brighton Ditch	63	11:11	60	105%
900	Wx-Aurora Reservoir	63	11:21	60	105%
4810	Shanahan Ridge	63	11:21	60	105%
1420	Wx-Diamond Hill	65	11:01	60	108%
1520	Wx-Marston Lake North	79	8:49	60	132%

Rain Event Performance			Reports Received		Analyze Rain Sensors											
		Systemwide Avg	Total Tips	161												
		94.41%	Data Loss	5.59%												
Description	Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket		
Newlin Gulch	3070	25%	0	1	0	0	0	1	0	2	8	6	0	0.0393701		
Red Hill	4290	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701		
Wx-Diamond Hill	1420	82%	7	2	0	0	0	0	0	9	11	2	0	0.0393701		
Wx-Urban Farm	1460	100%	8	0	0	0	0	0	0	8	8	0	0	0.0393701		
Wx-Tomah Rd-DougCnty	2990	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Wx-Sugarloaf	4730	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Wx-Salisbury Park	2730	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Wx-Quincy Reservoir	750	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Wx-Marston Lake North	1520	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701		
Wx-Louisville Lake	4750	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Wx-Highlands Ranch WTP	2710	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Wx-Elbert	1440	100%	3	0	0	0	0	0	0	3	3	0	1	0.0393701		
Wx-Cal-Wood Ranch	4770	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Wx-Button Rock	4790	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Wx-Brighton Ditch	1570	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Wx-Brighton	1920	100%	10	0	0	0	0	0	0	10	10	0	0	0.0393701		
Wx-Blue Mountain	140	100%	2	0	0	0	0	0	0	2	2	0	1	0.0393701		
WX-Bingham Lake Park	3030	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Wx-Aurora Town Hall	920	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Wx-Aurora Reservoir	900	100%	5	0	0	0	0	0	0	5	5	0	1	0.0393699		
Whispering Pines	4880	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
SBC @ SB Road	4870	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701		
SBC@S Boulder Ditch	4840	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701		
SBC @ San Souci	4830	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Doudy Draw	4820	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Shanahan Ridge	4810	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Eagle Ridge	4520	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Pinewood Springs	4510	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Little Narrows	4470	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Justice Center	4360	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701		
Conifer Hill	4350	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Riverside	4340	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Hansen Rain	4330	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Lee Hill Rain 2012	4320	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Johnny Park	4310	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701		
Cannon Mountain	4270	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Geer Canyon	4250	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Lazy Acres	4200	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Pine Brook	4170	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Sunshine	4160	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Gold Hill	4150	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701		
Logan Mill	4140	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701		
Swiss Peaks	4130	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Betasso	4110	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701		
Magnolia	4090	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Bear Peak	4070	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Lakeshore	4060	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
Walker Ranch	4050	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Martin Gulch	4040	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701		
Red Garden	4030	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
Crescent	4010	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
EPC at Hwy 105	3010	100%	1	0	0	0	0	0	0	1	1	0	0	0.01		
Dakan Rd	2980	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701		
W. Cherry Creek Wx	2790	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701		
		Total Tips	147	4	0	0	0	1	0	152	161	9	3			

2012 Monthly ALERT Radio Traffic Summary

