

Memo

Date: February 11, 2013
To: Kevin Stewart
From: Markus Ritsch
Subject: January 2013 ALERT Data Analysis

I. ALERT Data Source

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

II. General System Analysis Summary

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

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

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
A1	321,136											
A2	304,067											

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

Meteorological sensors account for 50 percent, water level sensors 2 percent, and rain sensors 2 percent of the total monthly records.

The system-wide radio traffic loading was 9,809 reports per day with an average hourly loading of 409 reports. The peak hour of radio traffic loading was 636 reports, which occurred on January 11th between 10:00 AM and 11:00 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 2) was questionable this month.

Table 2. Rain Sensors with Poor Performance Characteristics

Rain ID	Description	Timer	Event	Comments
1660	SPR at Henderson	79%	75%	
2330	Morrison	97%	50%	
2730	Wx- Salisbury Park	95%	100%	
2790	Wx- W. Cherry Creek	79%	100%	
2980	Dakan Road	95%	71%	
3010	EPC at Hwy 105	94%	100%	
3070	Newlin Gulch	47%	100%	
4470	Little Narrows	35%	29%	
2734 and 2733	Salisbury Park (site 2730) is sending data on undefined IDs			

B. Continuous Operation of Base Receiver/Decoder

The A1 and A2 data feeds on the NS5 base station were **NOT** in continuous operation for the entire month. Data reception was down on January 24th from 10:00 AM through January 25th at 1:00 PM.

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 3).

Table 3. Monthly Summary of Sensors with Poor Timer Performance (Sensor ID)

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470											
3070											
1660											
2790											
4870											
2320											

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

Statistical Parameter	Value	Comments
Mean	2.96	Only the 1-mm rain sensors were included in the analysis
Median	2	Only the 1-mm rain sensors were included in the analysis
Standard deviation	1.83	Only the 1-mm rain sensors were included in the analysis
Mean plus three standard deviations	8.44	Only the 1-mm rain sensors were included in the analysis
Minimum total count	0	Numerous stations
Maximum total count	7	Dakan Road/Tomah Road

B. Monthly Average Tip/Count Summary

A monthly summary of the District-wide mean total tip/count is presented (Table 5).

Table 5. Monthly Summary of District-Wide Mean Total 1-mm Tip/Count

Year	Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*	Ave
2006	4.62	5.92	18.39	20.47	19.44	13.75	74.03	46.89	24.17	41.13	5.04	16.45	24.19
2007	11.56	5.40	29.75	65.03	68.30	15.87	36.20	46.38	22.13	29.50	6.54	11.29	29.00
2008	4.05	7.38	12.26	20.57	54.82	26.06	16.43	90.20	37.54	19.59	2.82	9.24	25.08
2009	6.33	3.11	11.37	59.26	63.45	68.00	65.00	20.00	27.29	30.24	11.00	5.60	30.89
2010	5.97	11.90	32.54	70.57	39.63	56.04	50.23	31.01	4.18	18.31	8.30	3.31	27.67
2011	6.78	7.45	7.54	33.94	92.68	39.42	90.87	18.25	37.67	25.73	10.41	13.59	32.03
2012	4.89	13.57	2.35	30.17	38.97	19.35	73.03	11.31	48.81	22.32	2.98	4.18	22.66
2013	2.96												

*- 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 6).

Table 6. 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 96 percent. A total of 195 incrementing reports were received and a total of 204 reports were expected. The total loss of incrementing reports for the month was approximately 4 percent. Those sensors with the worst event transmission performance are summarized (Table 7).

Table 7. Monthly Summary of Sensors with the Most Missed Tips

Jan*	Feb*	Mar*	Apr	May	Jun	Jul	Aug	Sep	Oct*	Nov*	Dec*
4470											
2330											
2980											
1660											
--											
--											

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

Table 8. Periods of Heavy Radio Traffic

Day	Hour	Expected	Received	Total Load	Loss
11	10	0	0	636	0.00%
11	11	1	1	632	0.00%
11	2	0	0	632	0.00%
18	7	0	0	609	0.00%
19	4	0	0	606	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 9).

Table 9. Summary of Unknown IDs

Description	Quantity
Total number of unknown IDs (IDs without a device definition)	252
Total reports from unknown IDs	4,265
Unknown IDs with only a single received report (potential noise)	118
Total reports from all IDs – RecData Log entire month	304,067
Unknown reports as a fraction of total reports	1.40%

The total number of reports from unknown sensors is very small relative to the total reports received for the month. Shown below (Table 10) are the total reports received from unknown sensor IDs for each month of the year.

Table 10. Monthly Summary of Total Reports from Unknown IDs

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	1,220	1,474	1,276	1,174	721	5,707	610	1,738	442	533	2,857	6,396
2011	1,231	2,165	3,065	1,254	2,051	439	489	456	191	683	747	861
2012	692	750	1,575	977	5,469	11,016	453	683	774	2,657	3,854	5,466
2013	4,265											

The fraction of reports from unknown sensors relative to the total number of reports is shown below (Table 11).

Table 11. Monthly Percent of Unknown Sensor Reports

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.42%	0.56%	0.38%	0.32%	0.20%	1.61%	0.17%	0.49%	0.13%	0.16%	0.93%	1.88%
2011	0.39%	0.73%	0.90%	0.37%	0.58%	0.12%	0.12%	0.05%	0.12%	0.18%	0.22%	0.26%
2012	0.30%	0.25%	0.43%	0.26%	1.37%	2.74%	0.11%	0.18%	0.20%	0.72%	1.15%	1.62%
2013	1.40%											

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 12).

Table 12. Reports Received by Unknown IDs

Unknown ID	Reports
2734	3,082
2733	183
1423	39
2811	17
1486	31
1926	31
1470	36
2715	24
1934	23

General System Analysis

Database Name

P:\A207-UDFCD-Data-Analysis\2013\01-2013\Novastar_extract_20

First Date in Database

1/1/13 12:00 AM

Total Days

31.0

Last Date in Database

1/31/13 11:59 PM

Total Hours

744.0

Total Records Analyzed (A2 only)

304,067

Records by Group

Wind Data	109,007	36%
Temperature	60,758	20%
Relative Humidity	52,863	17%
Barometric Pressure	28,360	9%
Battery Voltage	10,597	3%
Solar Radiation	9,870	3%
Water Level	7,364	2%
Fuel Moisture	4,988	2%
Fuel Temperature	4,961	2%
Precipitation	4,654	2%
Unknown	4,265	1%
Soil Moisture	2,607	1%
Repeater Status Repor	2,308	1%
Flasher Status	653	0%
Repeater Pass List	514	0%
12Hr Status Report	275	0%
Solar Power	15	0%
Handar 585 ALARM Stat	6	0%
ALERT/A2 Testing	2	0%
Total	304,067	100%

Records by Major Group

Meteorologic Sensors	151,851	50%
Soil and Fuel Sensors	12,556	4%
Water Level Sensors	7,364	2%
Rain Sensors	4,654	2%
Sensor Status Transmissi	3,118	1%
Total	179,543	

Traffic Loading Summary

Alert Reports	304,067	
Average Daily Traffic	9,809	
Average Hourly Traffic	409	
Median Hourly Traffic	466	hour beginning
Peak Hourly Traffic	636	Jan 11, 10:00 AM
2nd Max	632	Jan 11, 2:00 AM
3rd Max	632	Jan 11, 11:00 AM
4th Max	609	Jan 18, 7:00 AM
5th Max	606	Jan 19, 4:00 AM

Rain Timer Performance

Analyze Rain Sensors

Rain Sensors	Description	Rcv	Timer	Exp	Performance
4470	Little Narrows	22	5:18	62	35%
3070	Newlin Gulch	29	12:25	62	47%
1660	SPR at Henderson	49	14:02	62	79%
2790	Wx-W. Cherry Creek	49	15:00	62	79%
4870	SBC @ SB Road	50	14:15	62	81%
2320	Choke Cherry Resvr	51	13:40	62	82%
4330	Hansen Rain	51	13:57	62	82%
4790	Wx-Button Rock	54	13:36	62	87%
1420	Wx-Diamond Hill	55	13:21	62	89%
4030	Red Garden	55	13:09	62	89%
4270	Cannon Mountain	55	13:17	62	89%
4240	Sunset	56	13:04	62	90%
4820	Doudy Draw	56	12:25	62	90%
2710	Wx-Highlands Ranch WTP	57	12:52	62	92%
4010	Crescent	57	12:51	62	92%
4850	Porphyry Mtn	57	12:13	62	92%
920	Wx-Aurora Town Hall	58	12:39	62	94%
3010	EPC at Hwy 105	58	12:39	62	94%
3030	WX-Bingham Lake Park	58	12:38	62	94%
4040	Martin Gulch	58	12:11	62	94%
4080	Twin Sisters	58	12:24	62	94%
4160	Sunshine	58	12:24	62	94%
4290	Red Hill	58	12:36	62	94%
4490	Apple Valley	58	12:23	62	94%
4510	Pinewood Springs	58	12:36	62	94%
4530	Winiger Ridge	58	12:36	62	94%
140	Wx-Blue Mountain	59	12:25	62	95%
2730	Wx-Salisbury Park	59	12:25	62	95%
2750	Wx-Castle Rock	59	12:24	62	95%
2980	Dakan Rd	59	12:26	62	95%
2990	Wx-Tomah Rd-DougCnty	59	12:26	62	95%
3020	Wx-West Creek WX	59	12:26	62	95%
4110	Betasso	59	12:12	62	95%
4180	Gold Lake	59	12:23	62	95%
4200	Lazy Acres	59	12:25	62	95%
4220	Fling's	59	12:23	62	95%
4340	Riverside	59	12:23	62	95%
4360	Justice Center	59	12:23	62	95%
4570	St. Antons	59	12:25	62	95%
4860	Fairview Peak	59	12:12	62	95%
700	Toll Gate @ 6th	60	12:00	62	97%
750	Wx-Quincy Reservoir	60	12:10	62	97%
1570	Wx-Brighton Ditch	60	12:00	62	97%
1640	SPR at Union Ave.	60	12:22	62	97%
1700	Cherry Cr @ Champa	60	12:12	62	97%
1810	Sand Creek at mouth	60	12:10	62	97%
2330	Morrison	60	12:02	62	97%
4020	Rio Grande	60	12:10	62	97%
4070	Bear Peak	60	11:58	62	97%
4130	Swiss Peaks	60	12:12	62	97%
4150	Gold Hill	60	12:10	62	97%
4170	Pine Brook	60	12:12	62	97%
4250	Geer Canyon	60	12:10	62	97%
4300	Big Elk Park	60	12:10	62	97%

4350	Conifer Hill	60	12:10	62	97%
4750	Wx-Louisville Lake	60	12:00	62	97%
4830	SBC @ San Souci	60	12:10	62	97%
4840	SBC@S Boulder Ditch	60	12:10	62	97%
4880	Whispering Pines	60	12:10	62	97%
970	Pump Sta 3	61	12:00	62	98%
1440	Wx-Elbert	61	12:00	62	98%
1460	Wx-Urban Farm	61	12:00	62	98%
2930	Wx-Spring Valley Rd-DougCnty	61	12:00	62	98%
4060	Lakeshore	61	11:45	62	98%
4090	Magnolia	61	11:58	62	98%
4100	Filter Plant	61	11:59	62	98%
4230	Golden Age	61	11:58	62	98%
4260	Taylor Mountain	61	11:58	62	98%
4520	Eagle Ridge	61	12:00	62	98%
4710	Wx-Ward C-1	61	12:00	62	98%
4810	Shanahan Ridge	61	11:57	62	98%
900	Wx-Aurora Reservoir	62	11:54	62	100%
1920	Wx-Brighton	62	12:00	62	100%
2210	Wx-Hiwan G.C.	62	11:54	62	100%
4050	Walker Ranch	62	11:46	62	100%
4140	Logan Mill	62	11:45	62	100%
4190	Slaughterhouse	62	11:45	62	100%
4310	Johnny Park	62	11:46	62	100%
4320	Lee Hill Rain 2012	62	11:45	62	100%
4730	Wx-Sugarloaf	62	11:48	62	100%
4770	Wx-Cal-Wood Ranch	62	11:48	62	100%
1000	Maple Grove Resv.	65	11:11	62	105%
1520	Wx-Marston Lake North	65	11:14	62	105%

		Reports Received	195											
	Systemwide Avg	Total Tips	204											
	95.59%	Data Loss	4.41%											
Description	Sensor	Performance	1-tips	2-tips	3-tips	4-tips	5-tips	6-tips	>6-tips	Rcv	Exp	Miss	Hold	Bucket
Little Narrows	4470	29%	1	0	0	0	0	1	0	2	7	5	0	0.0393701
Morrison	2330	50%	0	1	0	0	0	0	0	1	2	1	0	0.0393701
Dakan Rd	2980	71%	3	2	0	0	0	0	0	5	7	2	0	0.0393701
SPR at Henderson	1660	75%	2	1	0	0	0	0	0	3	4	1	0	0.0393701
Wx-Blue Mountain	140	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Toll Gate @ 6th	700	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Wx-Aurora Town Hall	920	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Maple Grove Resv.	1000	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Wx-Diamond Hill	1420	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
Wx-Urban Farm	1460	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Wx-Marston Lake North	1520	100%	6	0	0	0	0	0	0	6	6	0	0	0.0393701
Wx-Brighton Ditch	1570	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
SPR at Union Ave.	1640	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Cherry Cr @ Champa	1700	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Sand Creek at mouth	1810	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Wx-Brighton	1920	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Wx-Hiwan G.C.	2210	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Choke Cherry Resvr	2320	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Wx-Highlands Ranch WTP	2710	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
Wx-Salisbury Park	2730	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Wx-Spring Valley Rd-DougCnty	2930	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Wx-Tomah Rd-DougCnty	2990	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
Wx-West Creek WX	3020	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
WX-Bingham Lake Park	3030	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Crescent	4010	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Rio Grande	4020	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Red Garden	4030	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Martin Gulch	4040	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Walker Ranch	4050	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Lakeshore	4060	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Bear Peak	4070	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Twin Sisters	4080	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Magnolia	4090	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Filter Plant	4100	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Betasso	4110	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Swiss Peaks	4130	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Logan Mill	4140	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Gold Hill	4150	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Sunshine	4160	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
Pine Brook	4170	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
Gold Lake	4180	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Slaughterhouse	4190	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Lazy Acres	4200	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Fling's	4220	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Sunset	4240	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Geer Canyon	4250	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Red Hill	4290	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Johnny Park	4310	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Lee Hill Rain 2012	4320	100%	7	0	0	0	0	0	0	7	7	0	0	0.0393701
Hansen Rain	4330	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Riverside	4340	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Conifer Hill	4350	100%	4	0	0	0	0	0	0	4	4	0	0	0.0393701
Justice Center	4360	100%	6	0	0	0	0	0	0	6	6	0	1	0.0393701
Pinewood Springs	4510	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Eagle Ridge	4520	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Winiger Ridge	4530	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
St. Antons	4570	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Wx-Ward C-1	4710	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-Louisville Lake	4750	100%	2	0	0	0	0	0	0	2	2	0	0	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
Shanahan Ridge	4810	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393701
Doudy Draw	4820	100%	5	0	0	0	0	0	0	5	5	0	0	0.0393701
SBC @ San Souci	4830	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 @ SB Road	4870	100%	3	0	0	0	0	0	0	3	3	0	0	0.0393701
Whispering Pines	4880	100%	1	0	0	0	0	0	0	1	1	0	0	0.0393701
Wx-Aurora Reservoir	900	100%	2	0	0	0	0	0	0	2	2	0	0	0.0393699
		Total Tips	190	4	0	0	0	1	0	195	204	9	1	
EPC at Hwy 105	3010	100%	13	0	0	0	0	0	0	13	13	0	0	0.01
Porphory Mtn	4850	100%	2	0	0	0	0	0	0	2	2	0	0	0.01
Fairview Peak	4860	100%	3	0	0	0	0	0	0	3	3	0	0	0.01

2013 Monthly ALERT Radio Traffic Summary

