January 4, 2011

Kevin Stewart, P.E.
Urban Drainage and Flood Control District
Suite 156-B
2480 West 26th Avenue
Denver, CO 80211

Re: ALERT Gauging System Maintenance Program - End of Year Report

Dear Kevin,

OneRain is pleased to present you with the accompanying ALERT Gauging System 2011 End of Year Report. The purpose of the Report is to summarize the ALERT system maintenance activities completed by OneRain in 2011 on behalf of the Urban Drainage and Flood Control District (UDFCD) per our contract.

We believe that maintenance for the 2011 season was successful with a decrease in service calls required from the 2010 season. We are excited about the continued implementation of the ALERT2™ protocol and the positive impact it may have on more reliable data collection.

The accompanying Report includes a description of the overall system performance and problems encountered, recommendations for the upcoming 2012 season, and copies of our last round of maintenance records.

We want to thank you for allowing us to be your maintenance service provider for 2011. It is truly a pleasure to work with an owner who appreciates and understands the value of their flood warning system. We hope you are pleased with our service, and we look forward to our continued collaboration with the UDFCD. Please contact me with any questions.

Sincerely,

Mike Zucosky
Manager, Field Integration

OneRain
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UDFCD ALERT Gauging System Maintenance

Annual Report
January 4, 2011

Presented To
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Urban Drainage and Flood Control District
Denver, Colorado

By
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EXECUTIVE SUMMARY

The purpose of this report is to summarize the ALERT system maintenance activities completed by OneRain in 2011 on behalf of the Urban Drainage and Flood Control District (UDFCD) under our current contract.

We believe that maintenance for the 2011 season was successful with a small decrease in service calls required from the 2010 season. We are excited about the continued implementation of the ALERT2™ protocol and the positive impact it may have on more reliable data collection.

Beginning in the 2008 maintenance season, OneRain and the District modified the maintenance schedule slightly from previous years by including an interim trip to all rain gauge sites. Table 1 below summarizes the maintenance activity over the course of the last eleven years. The "Service Rate" column is the ratio (%) of service calls to sites in the combined UDFCD/Boulder System.

Table 1: Recent Maintenance Activity Statistics for UDFCD & Boulder Co.

Year	Total # of Visits	Service Calls OneRain/District	Number of Sites[1]	Service Rate
2001	701	66 (30/36)	152	43%
2002	723	59 (45/14)	161	37%
2003	794	110 (86/24)	171	64%
2004	790	78 (51/27)	173	45%
2005	810	97 (76/21)	174	56%
2006	696	97 (78/19)	182	53%
2007	653	58 (49/9)	183	32%
2008	715	94 (62/32)	194	48%
2009	715	107 (93/14)	179	60%
2010	744	82 (81/1)	180	45%
2011	680	78 (69/9)[2]	180	43%

[1] This total number of sites includes repeaters and base stations.

[2] Count does not include one 'administrative' maintenance record which documented battery disposal

SYSTEM PERFORMANCE

We had a total of 680 maintenance records; There were 69 service calls initiated by OneRain, and 9 service calls initiated by others In addition, there was one administrative maintenance record included which documented battery disposal.

Service calls

Of the sixty nine service calls initiated by OneRain, they are broken down as follows:

- 21 Power issues
- 16 Pressure Transducer issues
- 10 Transmitter Related issues
- 9 Tipping Bucket issues
- 5 Data Logger issues
- 5 Repeater related issues
- 2 Bubbler related issues

Of the nine service calls not initiated by OneRain, one was due to damage of the pressure transducer conduit at the Kelly Dam site during construction, four were for miscellaneous reasons, two for transmitter issues, one for site removal and one for pressure transducer drift,

Key factors of the unscheduled visits can be attributed to the following:

Transmitter issues – Service calls due to transmitter related issues were lower than in previous years; however, they continue to constitute a large percentage of service call visits. Transmitter related issues encompass a wide array of on site issues from dead radios and program corruptions to transmitter failures.

Power issues – Due to a continuing aging battery fleet, a number of batteries did not survive the interval between standard preventative maintenance visits.

Data logger issues – Due to program corruption of unknown cause, mostly in older model data logger units.

Repeater issues – Site visits were associated with equipment modifications for ALERT2 and frequency splitting, and pass-list/program corruptions.

Miscellaneous issues – Service calls for miscellaneous issues included antenna and radio replacements as well as minor repairs and adjustments.

Pressure Transducers – Out of the 16 Pressure Transducer service calls, 8 were due to PT failures/replacements. The remaining service calls were calibration adjustments and miscellaneous repairs. No signal conditioning failures were encountered this year.

Pressure Transducer Failures and Replacements

PT failures were consistent with previous maintenance years with one new pressure transducer location installed this year. Overall, 61 pressure transducer calibrations were performed. This number is higher than usual due to faulty test equipment, which has been replaced. Specific details of pressure transducer activity are as follows:

A new pressure transducer was installed at the following site:

- South Boulder creek @ South Boulder Road (4870)

Pressure transducers were replaced at the following sites:

- Slaughterhouse (1620) – replaced 3/15/11
- Sand Creek Park (1800) – replaced 3/15/11
- Goldsmith at Eastman (640) – replaced 5/10/11
- Piney Creek @ Liverpool (950). – replaced 5/10/11
- Aurora regional Pond(940) – replaced 5/16/11
- Marston Wx (1520) – replaced 5/17/11

Other Pressure Transducer issues:

- The pressure transducer intake at Four Mile (4410) required multiple visits to clear the intake conduit, post event.
- Based on 2011 records, one planned pressure transducer replacement is currently scheduled for Cub Cr. Below Blue (2270). As always, all sensors will be tested and evaluated during spring start-up.

Damaged Equipment/Other Replacements

Gold Hill Repeater (8015)

Beginning in December of 2010, a large number of unknown sensor ID's began reporting in the ALERT system. After investigation, the issue was isolated to the Gold Hill Repeater. The unit was replaced prior to spring start up activities, correcting the issue.

Broadway @ Canyon (4583)

The pressure transducer and its associated conduit were damaged during construction activities at the site. The conduit was repaired and the pressure transducer was replaced prior to spring start-up activities. In addition, the Maxon radio at this site was also replaced due to signal degradation.

Green Ditch (4590)

The site began to experience intermittent transmission reliability. The existing Maxon radio at this site was replaced on 1/28/2011 with a Ritron radio after the existing unit showed deterioration in output power. The site reported reliably through the rest of the season. This site is scheduled for a data logger upgrade in January of 2012, funded through the City of Boulder.

Flying J (850)

The site began to experience intermittent transmission reliability. The Maxon radio at this site was replaced on 3/1/2011 after the existing unit showed deterioration in output power. The site reported reliably through the rest of the season.

Boulder Falls (4390)

The pressure transducer at this site was reporting bad values intermittently during short intervals. The transmitter and signal conditioning were replaced on 3/31/2011. The existing pressure transducer calibrated correctly and was left in place. The site reported reliably through the rest of the season.

Hills Mills (4710)

The battery at the site died during the winter due to solar panel failure. The solar panel and voltage regulator was replaced at the site once access was available on 6/16/2011. The site is currently reporting reliably.

Cherry Creek @ Champa (1700)

The site began to experience intermittent transmission reliability. The Maxon radio at this site was replaced on 6/17/2011 after the existing unit showed deterioration in output power. The site is currently reporting reliably.

Ferril Lake (1380)

The site began to experience intermittent transmission reliability. The Maxon radio at this site was replaced on 7/20/2011 after the existing unit showed deterioration in output power. The site is currently reporting reliably.

Aurora Reservoir (900)

After reporting bad temperature values, the site was visited on 10/4/2011. The data logger program was found to be corrupted. In addition, the site is not reporting reliably. The Maxon radio was replaced on 10/31/2011; however, this did not improve transmission dependability. We suspect the data logger, which is an out of date model, is no longer performing properly and recommend its replacement.

South Boulder Creek @ SBC Ditch (4840)

The intake for the pressure transducer was damaged due to stream re-routing. The intake positioning was corrected on 10/10/2011. The site is currently reporting reliably.

Justice Center (4360)

The solar panel at this site was replaced and a solar regulator was installed on 11/22/2011 after the existing unit failed.

New Site Installations

South Boulder Creek @ South Boulder Road (4870)

A new site was installed along South Boulder Creek on 10/24/2011. The site is located at Latitude 39° 58' 25", Longitude -105° 13' 1", Elevation. This site reports via the Gold Hill Repeater. In addition to rainfall, the site also reports stage via a pressure transducer.

2012 Upgrades, Rehabilitations, and Relocations

The following items are currently under contract and will be completed in early 2012:

Diamond Hill (9100)

All ALERT and ALERT2 data receiving and decoding equipment, including cables and connector, will be relocated from Diamond Hill Suite 156-B to Suite 310-B.

Croke Pump Station (120)

The pressure transducer conduit was damaged during installation of other conduits by the City of Arvada near the gauging station. The conduit will be repaired and the pressure transducer reference level will be re-established.

Henderson (1660)

The existing ALERT gauging station will be relocated from the east bank to the west bank of the South Platte River to be co-located with the existing DWR gauging station.

Eldorado Springs (4380)

The existing ALERT gauging stations will be relocated upstream to be co-located with the existing DWR gauging station.

Marston Lake (1520)

The existing data logger equipment will be upgraded from a CR10X to a CR850 data logger.

Blue Mountain Repeater

Early in 2010, the Blue Mountain Repeater began to experience temperature related loss of signal on the 169.500 MHz frequency, typically at temperatures less than 20° F. After discussion and analysis with the manufacturer, the audio mixer/combiner was replaced on 5/21/10. Unfortunately, the site is still experiencing issues at low temperatures and we are continuing to work with the manufacturer to determine the cause of the issue and rectify it.

This issue is currently seen only on the standard ALERT channel and has not impacted the ALERT2™ channel.

Miscellaneous Activity of Note

FCC Licensing

To date, OneRain has received confirmation for renewed or extended licensing on all sites and call signs. As new sites are installed OneRain will keep the licenses up to date.

The re-licensing of sites that were changed to the 169.500 MHz frequency is on-going.

FUTURE AREAS OF INTEREST

The sections below outline areas that the District and OneRain have been tracking through our monthly meetings, or areas of future concern we want to make you aware of.

ALERT2™ Transmitters

With the on-going development of the ALERT2™ protocol, we recommend that the spare transmitter units required for on-going operation of the network are 3306 units in lieu of 3206. While the cost of the units is slightly higher, when the production network changes to the ALERT2™ protocol, the 3306 units will allow for a more cost effective updating of gauges to transmit ALERT2™ messages. In addition, the 3306 units also provide increased flexibility and configuration over the 3206.

Pressure Transducer Replacement

Based on 2011 records, one planned pressure transducer replacement is currently scheduled. As always, all sensors will be tested and evaluated during spring start-up.

Shared USGS Sites

The USGS change to Sutron SatLink-2 (SDI-12) equipment impacted two sites: Cherry Creek @ Champa (1700) and SPR @ Union (1640). Although we were able to re-instate the 8200 functionality and prevent any major failures during the 2010 & 2011 maintenance year, we still consider the equipment unstable and there are no spares in stock. In the event of 8200 failures, upgrading these sites to Campbell Scientific data loggers would provide a more stable system.

CR 10X Data Logger Sites

CR 10Xs are now obsolete. We will continue to make recommendations to upgrade the remaining sites where the 10X is still in use.

SPARE EQUIPMENT RECOMMENDATIONS FOR UPCOMING SEASON

1. Radio
    a. Spare Maxon Radio - recommend purchasing 2
    Cost at (2) x $211 each = $422

2. Pressure Transducer
    a. Druck PDCR 1830: 100mV, 10psi - 160'
    Cost = $925

    b. Druck PDCR 1830: 100mV, 10psi - 100'
    Cost = $820

    c. Druck PDCR 1830: 100mV, 10psi - 50'
    Cost = $730

Total cost = $2,897

APPENDIX A: SPARES ON HAND

Sensors	
Tipping Bucket – High Sierra 2400-3	4 each
RH/AT Sensors – Vaisala HMP 45A	5 each
Anemometer – Wind Speed Hydrolynx	1 each
Wind Vane – Wind Direction Hydrolynx	1 each
Handar sensors (removed from Quincy (used)):	
Wind Speed	1 each
Wind Direction	1 each
Air Temperature and Humidity	1 each
Solar Panels	
110mA	3 each
5W	1 each
Pressure Transducers	
Druck PDCR 1830 10psi 100mV 50 feet	1 each
Druck PDCR 1830 10psi 100mV 120 feet	1 each
Repeaters	
Hydrolynx 50386 dual frequency	2 each
Transmitters	
Hydrolynx 5096	2 each
Hydrolynx 5096-81 Wx (Questionable Performance)	1 each
High Sierra 3206 (combined UDFCD/BoCo)	2 each
High Sierra 3306 (combined UDFCD/BoCo)	5 each
Antennae	
DB222 (UDFCD)	1 each
Omni (UDFCD)	3 each
Yagi (UDD)	1 each
Omni (BoCo)	1 each
Yagi (BoCo)	1 each
Radios	
Maxon	2 each
Misc.	
20 Watt Power Amp	1 each
Signal Conditioning Module	8 each

APPENDIX B: MAINTENANCE RECORDS (PER SEPARATE PDF ACCOMPANYING THIS DOCUMENT)

APPENDIX C: PT CALIBRATION LOG (PER SEPARATE PDF ACCOMPANYING THIS DOCUMENT)

APPENDIX D: INVENTORY (PER SEPARATE PDF ACCOMPANYING THIS DOCUMENT)