UDFCD ALERT Gauging System Maintenance 2012 Annual Report

Kevin Stewart
Urban Drainage and Flood Control District
Denver, Colorado

Prepared By
OneRain Incorporated
1531 Skyway Drive, Unit D
Longmont, Colorado 80504

Report Date: December 10, 2012

Table of Contents

Tables and Figures

Executive Summary

Introduction

The purpose of this report is to summarize the ALERT system maintenance activities completed by OneRain in 2012 on behalf of the Urban Drainage and Flood Control District (UDFCD) under our current contract.

We believe that maintenance for the 2012 season was successful with a decrease in service calls required from the 2011 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%
2012	692	67 (53/14)[2]	176	38%

[1] This total number of sites includes repeaters and base stations.
[2] Count does not include 'administrative' maintenance records which document battery disposal

System Performance

We had a total of 692 maintenance records; there were 53 service calls initiated by OneRain, and 14 service calls initiated by others. In addition, there were 9 installations, 5 repairs, 2 administrative, and 2 other maintenance records.

Service Calls

Of the fifty-three service calls initiated by OneRain, they are broken down as follows:

- 22 Power issues
- 16 Pressure Transducer issues
- 7 Transmitter Related issues
- 2 RF related issues
- 3 "other" related issues
- 2 Tipping Bucket issues
- 1 Shaft encoder issue

Of the fourteen service calls not initiated by OneRain the break out is as follows:

- 5 Transmitter Related issues
- 4 Power Issues
- 1 Bubbler
- 1 "Other" related issue
- 1 Pressure Transducer issue
- 1 RF related issue
- 1 TB related issue

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

- **Transmitter issues** – Transmitter related issues 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.
- **Other issues** – Service calls for miscellaneous issues included antenna and radio replacements as well as minor repairs and adjustments.
- **Pressure Transducers** – Out of the 17 Pressure Transducer service calls, 11 were due to PT failures/replacements. Two service calls were for signal

conditioning calibration and replacement. The remaining service calls were calibration adjustments and miscellaneous repairs.

Pressure Transducer Failures and Replacements

PT failures were higher than previous years. This is mainly due to an increased number of vandalism incidents. In addition, two new stage gauges were installed this year. Overall, 77 pressure transducer calibrations were performed. This number is higher than previous years which is due to the increased number of PT replacements. Specific details of pressure transducer activity are as follows:

New pressure transducers were installed at the following sites:

- W. Cherry Creek Weather Station (2790)
- Antelope (2780)

Pressure transducers were replaced at the following sites:

- Little Narrows (4470) – replaced 4/23/2012
- Croke Pump Station (120) – replaced 4/24/2012
- Sand Creek Mouth (1810) – replaced 5/29/2012
- Horseshoe Park (710) – replaced 6/6/2012
- Sable Ditch (800) – replaced 6/6/2012
- Powers Park (1500) – replaced 7/2/2012
- Niver Detention (1900) – replaced 7/2/2012
- Sand Creek Park (1800) – replaced 7/16/2012
- Green Ditch (4590) – replaced 8/31/2012
- SPR @ Mausoleum (1320) – replaced 9/4/2012
- Slaughterhouse (1620) – replaced 9/4/2012

Other Pressure Transducer issues:

- Confluence Pond (720) and DIA at Third Creek (1480) experienced vandalism to their conduit. At each site, the pressure transducer functionality was not impacted. The conduit has been repaired at both locations.

Damaged Equipment/Other Replacements

Croke Pump Station (120)

Due to extensive conduit damage, the pressure transducer was unable to be maintained sufficiently. On April 24th OneRain officials re-installed the conduit and pressure transducer resolving the maintenance problem.

Kelly Dam (410)

Due to drainage reconstruction, the Kelly Dam pressure transducer has been out of service for the calendar year. On November 29, 2012, after construction at the dam was completed, new conduit was installed to the new outlet structure.

Tollgate (700)

The bubbler line was severed by the USGS during a site upgrade. After consultation with the UDFCD, it was decided to leave the site as a rain only gauge.

Confluence Pond (720)

The hydraulic intake pipe was found vandalized on September 13, 2012. On October 1, 2012 the conduit was replaced, restoring hydraulic contact. During the service call, a pull box was added, facilitating future maintenance work.

Quincy (750)

The pyronometer was replaced on August 14, 2012 due to an unexpected failure. During this visit, the radio was also replaced due to poor performance.

Aurora Regional Pond (940)

Due to high rainfall in June, the Aurora Regional Pond standpipe flooded causing the transmitter to malfunction. The transmitter was replaced on June 12, 2012.

Powers Park (1500)

The Pressure Transducer began to over report in late June. On June 22, 2012 the PT was discovered to have been cut by a lawnmower. The PT was replaced July 2nd.

Marston (1520)

Due to a faulty enclosure and aging CR10X data logger, the site was upgraded with a new enclosure, backplane, and CR850 on February 17, 2012.

SPR @ Union (1640)

SPR was upgraded from legacy equipment to a 3306 transmitter on April 12, 2012 due to existing transmitter reporting bad data values. The 3306 was configured to request data from the USGS bubbler via the SDI-12 data line. Due to reliability concerns, the USGS requested that the line be disconnected. As of June 1, 2012 the site is functioning as a rain only gauge.

SPR @ Henderson (1660)

The site was relocated on March 9, 2012 to a new CDWR location. The stilling well was replaced with a bubbler installation. A new 3306 transmitter was installed to request data from the bubblers SDI-12 data line. On July 11, 2012 the data line was disconnected due to interference with the CDWR equipment. The site is now rain only.

Sand Creek Park (1800)

The pressure transducer was found vandalized and cut on October 4th, 2012. Due to the end of season and the PT's susceptibility to freezing, the PT was removed and will be replaced in the spring with a designated spare. The conduit was also re-configured to prevent winter freezing.

Johnny Park (4310)

The site stopped reporting on October 21, 2012. Upon inspection it was determined that the site was shot multiple times with a hand gun. The RF cable was severed ceasing transmissions. The cable was replaced on November 7, 2012.

Eldorado Springs (4380)

The site was relocated on March 16, 2012 to a new CDWR location. The stilling well was replaced with a bubbler installation. A new 3306 transmitter was installed to request data from the bubblers SDI-12 data line.

Green Ditch (4590)

A new Data Logger, Communications Engine, and Pressure Transducer were installed on January 19, 2012 as a site upgrade to Green Ditch. The site was stolen on July 10, 2012. All new equipment was re-installed on August 31.

Gold Hill Repeater (8015)

The antenna mast mount was discovered broken during standard spring start up maintenance. A temporary fix was implemented at this time. In August the broken bracket was repaired.

New Site Installations

Whispering Pines (4880)

A new site was installed within the four mile burn area on 4/27/2012. The site is located at Latitude 40.0605556°, Longitude -105.3647222°. This site reports via the Lee Hill Repeater. Whispering Pines is a rain only site.

Figure 1: Whispering Pines

Lee Hill Rain (4320)

A new site was installed within the four mile burn area on 4/27/2012. The site is located at Latitude 40.0719444°, Longitude -105.3541667°. This site reports via the Lee Hill Repeater. Lee Hill Rain is a rain only site.

Figure 2: Lee Hill Rain

Antelope Creek (2780)

A new site was installed for Douglas County on 6/21/2012. The site is located at Latitude 39.2636111°, Longitude -104.7161111°. This site reports via the West Creek Repeater. Antelope Creek is a stage only site.

Figure 3: Antelope Creek

W. Cherry Creek Wx (2790)

A new site was installed for Douglas County on 6/21/2012. The site is located at Latitude 39.2619444°, Longitude -104.7088889°. This site reports via the West Creek Repeater. W. Cherry Creek Wx is a full weather station including relative humidity, air temperature, barometric pressure, wind direction, wind speed, peak wind gust, precipitation, and stage.

Figure 4: W. Cherry Creek Wx

2013 Upgrades, Rehabilitations, and Relocations

The following items are currently under contract and will be completed in early 2013:

Carr Street (100)

Carr Street has been removed since October 28, 2011 due to reconstruction. The site will be re-installed once construction is complete.

Ralston Reservoir (110)

The pressure transducer at Ralston Reservoir started reporting erratic readings during the month of October. Due to high water levels, the PT could not be accessed and replaced. Denver Water will contact OneRain when water levels subside and the PT can be accessed. New conduit will also be installed granting easier access to the PT during high water.

Squaw (2190)

Squaw mountain weather station was removed on September 21, 2012 due to tower reconstruction. The site currently has not been re-installed. OneRain recommends that the site not be re-located on the new tower due to access concerns. We are currently in negotiations with the United States Forest Service for a terrestrial based installation in spring.

Justice Center (4360)

Justice Center experienced poor rain catch for a majority of the 2012 rain year due to roof construction at the Justice Center. Due to tight security and roof access, this site has been approved for relocation to the South East corner of the lawn. This installation is scheduled for January 2013.

Blackstone

Scheduled for install in early 2013, Blackstone will be located at the intersection of Monaghan and Smokey Hill Parkway at the waste water lift station. OneRain is currently in contact with the City of Aurora finalizing site details.

Miscellaneous Activity

Diamond Hill

Due to UDFCD office construction the ALERT2 receiver/decoder was relocated from the first floor to the third floor server room. Additional problems persisted with the ALERT2 feed throughout the year. Faulty batteries were replaced which powered the ALERT2 decoders. Furthermore, an incorrect IP address was assigned to the ALERT2 port server which caused a minor ALERT2 outage. This issue was resolved with an updated static IP address.

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. With the full switch to ALERT2, this issue will no longer be present.

FCC Licensing

To date, all licensing is up to date. However, with the scheduled frequency change to 169.500 this winter, all licensing will need to be updated.

Benchmark Metadata

By end of year 2012, all benchmark data for stage gauges will be complete. This data references the vertical distance between the sensor reading level and a designated reference point. Photographs and documentation have been provided for each location.

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™ Upgrade

Scheduled for early 2013, all ALERT2 repeaters will be upgraded to receive both ALERT2 and legacy ALERT. Once this upgrade is complete, ALERT2 gauges can be implemented.

ALERT2™ Transmitters

Once the ALERT2 upgrade is complete, OneRain recommends implementing a few gauges from the three major ALERT2 manufactures:

- High Sierra
- Hydrolynx
- Campbell

With a variety of manufactures implemented, testing can be performed resulting in a vendor of choice.

Pressure Transducer Replacement

Based on 2012 records, two planned pressure transducer replacement are currently scheduled and will be replaced with existing spares at spring start-up:

- Sand Creek Park (1800)
- Murphy Creek (870)

Recommended Pressure Transducer Replacements

OneRain recommends that the following pressure transducers be replaced due to slipping performance, however spare equipment will need to be purchased to complete this work. Pricing for equipment to replace these sensors is included in the spare equipment table below.

- Ralston Reservoir (110)
- Fourmile at Salina (4410)

As always, all sensors will be tested and evaluated during spring start-up.

Secondary ALERT2 Base Station

A secondary ALERT2 base station is scheduled for install in 2013. The planning of the base station is currently in progress.

Metadata Consistency

OneRain will continue to work with WET and other agencies to integrate database metadata ensuring accuracy and consistency.

Spare Equipment Recommendations for Upcoming Season

Table 2: Spare Equipment Recommednations

Manufacturer	Model	Cost	Quantity	Total	Notes
Maxon	SD125E	$211	3	$633	
Druck	PDCR 1830-160	$925	1	$925	160' PT
Druck	PDCR 1830-120	$900	1	$900	120' PT
Druck	PDCR 1830-100	$820	2	$1,640	100' Ralston Replacement, 100' Spare
Druck	PDCR 1830-75	$800	1	$800	75' Fourmile Replacement
HSE	Top Screens	$55	4	$220	
BWD	R2011 A2 Decoder	TBD	1	TBD	Low power version
BWD	G2010 A2 Encoder	TBD	1	TBD	Low power version
			Total	**$5,118**	Excluding BWD equip.

Appendix A: Spares on Hand

Per separate PDF accompanying this document

Appendix B: Maintenance Records

Per separate PDF accompanying this document

Appendix C: PT Calibration Log

Per separate PDF accompanying this document