Castle Pines North Metropolitan District Irrigation Control System Demonstration 100% Completion Report January 2010

Grant Recipient: Castle Pines North Metropolitan District
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The Castle Pines North Metropolitan District (District) developed a Water Conservation Plan that was approved by the Colorado Water Conservation Board (CWCB) in the summer of 2006. One of the goals set forth in that Plan was to closely monitor District irrigation on parks and open space. In efforts to meet this goal and conserve water, the District proposed to install a CALSENSE irrigation management system to optimize irrigation rates and increase water savings.

This 100% Completion Report is the final document for fulfillment of CWCB's Water Efficiency Grant Program requirements. This document contains a project overview, and provides a discussion of findings and a summary of water savings from the project. The approved grant application for this project is included as Attachment A for reference and provides information on the district's water demands and supplies, and water conservation program.

This 100% completion report includes the following major sections:

- Section 1: Irrigation Management System Overview
- Section 2: Scope of Work
- Section 3: Final Schedule and Budget
- Section 4: Project Findings and Water Savings

The following sections discuss the CALSENSE irrigation management system, the execution of the project and present water savings data from 2009, after one full year of project operation.

1.0 Irrigation Management System Overview

CALSENSE water management system products have been available on the market since 1986. A variety of technical features have been added to these systems providing greater central control and improved irrigation efficiencies. These systems have been installed throughout the United States including California, Nevada, Arizona, Texas, Utah, and New Mexico. Through this project, the District has become one of the first providers in Colorado to use a CALSENSE irrigation management system (Irrigation Management System). The District has implemented the Irrigation Management System in a series of District-owned and operated parks and has documented observed differences in water use associated with implementation of the Irrigation Management System.

1.1 Major Components

The District worked with Ewing Irrigation, a CALSENSE distributor, in determining the equipment needed to best meet the District's irrigation management needs. The District used the following major components (obstacles encountered with these major components are also included):

- ***Weather Station*** – A weather station was installed in the District service area. This station measures weather parameters such as temperature, wind speed, and radiation used to estimate evapotranspiration (ET). Daily ET rates are estimated and used to regulate irrigation application rates. The weather station also measures precipitation and is used to regulate irrigation application rates. Initially, the weather output data from the weather station were too detailed for the District's purposes and cumbersome to read. The District purchased a software program that consolidated the data into a readable format.

- ***Valves*** – Valves were installed at each major irrigation zone and can be controlled remotely (either manually or automatically) to adjust/shut off flows.

- ***Flow Meter*** – Flow meters were installed to measure flows at each major irrigation zone. This information is collected by the central control station.

- ***Central Control and Reporting Station*** – This station collects electronic data from the weather station, sensors, and control valves. These data are recorded and operators have the option of accessing these data in real time. The central control station is also able to automatically adjust flow rates throughout the system based on ET rates and other parameters specified by the operator. The operator is also able to manually adjust flow rates remotely via this central control station. The District experienced difficulty in programming the central control station computer. Remote assistance from the CALSENSE contractor did not prove to be sufficient and a CALSENSE technician had to be brought in to address the programming issues on-site.

- ***Communication System*** – This system provides communication between the aforementioned components. CALSENSE offers radio, cell phone, and hard wire communication. An assessment conducted by Ewing Irrigation on the District service area concluded that radio communications was the optimal communication system for the District service area. The wireless technology did not work as originally planned due to the locations of some of the valve meters and controllers in relation to the central control station computer. The District subsequently set up a system using cell phone technology that has met the District's needs.

1.2 Major Features

The Irrigation Management System provides the following beneficial features that have improved the District's irrigation efficiency:

- Automatically adjusts irrigation application rates based on real time measured ET values and precipitation. This prevents over-watering by ensuring that landscaping is only provided the amount of water it needs.

- Automatically shuts an irrigation system zone off if the sensor measures a sudden significant change in flow typical of a pipe burst/leak. This immediate response prevents water wasting from leaks that can go undetected for days. Water leaks are reported at the central control station, indicating to operators which valve(s) were shut off and the general location of the leak.

- Records irrigation application rates and the amount of water used at each irrigation zone. This provides a detailed record of the District's water use patterns and can be used to estimate water savings.

- Water budgets can be inputted into the central control station for each irrigation zone. The control station would notify the operator(s) when a water budget may be exceeded. Irrigation application rates can also be adjusted to remain within a specified water budget for a period of time. This could be of significant benefit during times of drought, enabling the District to tightly control the amount of water applied to each irrigation zone (regardless of ET requirements).

- Irrigation times can be specified for each irrigation zone to ensure that irrigation would not occur during daylight hours to minimize evaporation losses during irrigation. Also, the timing of irrigation in different zones can be optimized to use the maximum amount of water available at a given time. This ultimately shortens the irrigation window and can help prevent the soaking of turf just prior to high usage.

2.0 Scope of Work

This scope of work provides a general description of the project and outlines the major tasks, roles, and responsibilities of each party involved. The District completed the installation of the Irrigation Management System in late October 2007 and had the

portions of the system running by May of 2008. The final schedule and project budget for each of these tasks are also provided in this section.

2.1 Project Overview

The District installed the Irrigation Management System at the following six District irrigated parks, in accordance with the scope of work for the approved grant:

- Retreat Park
- South Open Space Park
- North Open Space Park
- Upper Coyote Ridge Park
- Lower Coyote Ridge Park
- Daniels Gate Park

Figure 1 shows the location of these parks within the District service area as well as the number of irrigated acres at each park. The Irrigation Management System is used to control irrigation for approximately half of the District's irrigated landscaping area.

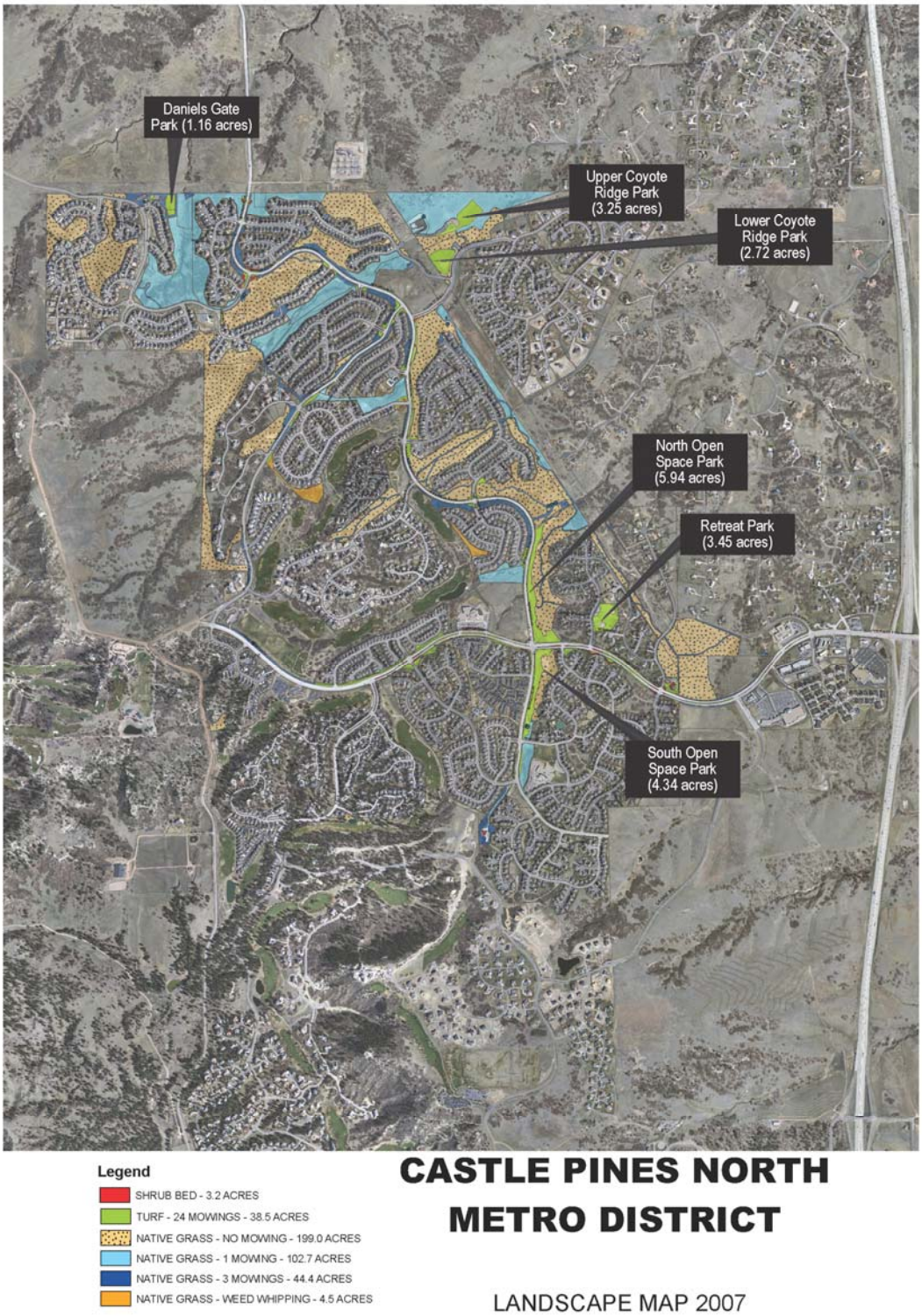

Figure 1
Parks Irrigated Using the Irrigation Management System

2.2 Project Tasks

The following tasks outline the major actions completed to install and initiate operation of the Irrigation Management System. The roles and responsibilities of each participant and deliverables for each task are also provided. The District has met their goals and objectives for the installation of the Irrigation Management System. The installation of the equipment was achieved as planned and no major obstacles were encountered. However, the District encountered several challenges with the operational set up of the central control station, communications system, and the weather station (see Section 1.1). Project modifications are also included below.

Task 1 – Phase I Installation

Purpose

This task involved the installation of the weather station, central control station, meters, valves, and communication accessories needed to manage the irrigation on Upper Coyote Ridge and Lower Coyote Ridge parks. Modifications to this task included changing the communication system to cell technology from the originally scoped radio system, and the additional purchase of the weather station software. These modifications did not affect the requested funding amount from CWCB as presented in the original grant application. This task was completed in October 2007.

Roles and Responsibilities

The District purchased the equipment from Ewing Irrigation. Ewing Irrigation worked closely with the District in installing the equipment. Parker Electric was responsible for the installation of electrical lines for the centralized Weather Station. The District coordinated and facilitated the installation effort with representatives from CALSENSE and Ewing Irrigation.

Task 2 – Phase II Installation

Purpose

This task involved the installation of the remaining meters, valves, and communication accessories needed to manage the irrigation on Retreat Park, South Open Space Park, North Open Space Park, and Daniels Gate Park. This task was completed in May 2008.

Roles and Responsibilities

The District purchased the equipment from Ewing Irrigation. Ewing Irrigation worked closely with the District in installing the equipment. The District was responsible for coordinating and facilitating the installation effort. Because of the linear nature of the parks in Phase II, Clearwater Landscaping was contracted to pull wire in from the irrigation controllers to the master valve and master meter at each park site.

Task 3 – Operational Set Up and Initial Monitoring

Purpose

This task involved the operational set up of the equipment following installation and developing a protocol for recording monitoring data. This task was completed in May 2008. In addition to monitoring data, the District has taken the output from the weather station and placed it on their web site for residents to monitor real-time weather conditions in Castle Pines North. The site also provides information on water conservation and includes a link to the District's water conservation program.

Roles and Responsibilities

CALSENSE and Ewing Irrigation staff provided the District technical assistance and training in operating the equipment and educating District staff on the central control station's software in May 2008. The District also distributed information to their customers and general public on the Irrigation Management System.

Task 4 – CWCB Grant Development and Status Reports

Purpose

This task involved the development of a 50 percent, 95 percent, and a final completion status report to CWCB per the CWCB Water Efficiency Grant Requirement.

Roles and Responsibilities

The District used Camp Dresser & McKee Inc. (CDM) to develop the grant application and subsequent completion reports.

3.0 Final Project Schedule and Budget

The final project schedule identifying key activities and milestones is presented in Table 1.

Table 1 Final Project Schedule

Task	Anticipated Completion Disclosed in the Application for Water Efficiency Grant	Revised Completion Date
Order Phase I materials and initiate installation*	Middle of July 2007	Completed end of September 2007
Complete installation of Phase I materials*	Mid/End of October 2007	Completed end of October 2007
Complete set up/training and begin operations*	Mid/End of October 2007	Completed May 2008
Submit 50 percent completion reports to CWCB	End of October 2007	Submitted to CWCB end of December 2007
Complete installation of Phase II materials	End of October 2007	Completed May 2008
Submit 95 percent completion report to CWCB	Beginning of November 2007	Submitted to CWCB February 2009
Complete set up and begin operation of new equipment	Beginning of 2008 irrigation season	Completed May 2009
Submit final completion report to CWCB	2008 irrigation season	Submitted to CWCB December 2009
Collect monitoring data and estimate irrigation water savings	End of 2008 irrigation season	Completed December 2009

The final cost data are provided in Table 2. These data provide information on the District's in-kind contributions (i.e., staff time and capital expenditures), and allocation of costs based on grant funding from CWCB.

Castle Pines North Metropolitan District
FINAL BUDGET
January 2010

Table 2 Costs and Cost-Sharing Allocation Presented in the Application for Water Efficiency Grant

		Estimated Expenditures						Funding Sources			
		Ewing Irrigation		Clearwater Landscaping	Parker Electric	District Staff Costs					
Task	Description	CALSENSE Material	Technical Asisstance	Installation of Pull in Wire	Installation of Electrical Equipment	Staff Labor Costs	TOTAL	District Match (Cash Funds)	CWCB Grant	District Match (In-kind Services)	Total
1.0	Phase I Installation	$29,176	$0	$1,383	$0	$9,260	$39,820	$1,219	$29,341	$9,260	$39,820
2.0	Phase II Installation	$35,149	$0	$1,638	$0	$9,177	$45,964	$9,936	$26,850	$9,177	$45,964
3.0	Operational Set Up & Initial Monitoring	$0	$0	$0	$0	$7,624	$7,624	$0	$0	$7,624	$7,624
Total		**$64,325**	**$0**	**$3,021**	**$0**	**$26,061**	**$93,407**	**$14,239**	**$56,191**	**$26,061**	**$93,407**

4.0 Project Findings and Water Savings

The District has successfully completed the installation of the Irrigation Management System. Although several obstacles were encountered, the District was able to address each issue without significant delays. The District is very pleased with the overall operation of the system. During the summer of 2008, the District spent considerable time and effort promoting the project. The District coordinated and participated in three separate workshops during which the control system was presented to HOA management companies, HOA board members, and HOA landscape contractors. As a result of these efforts, one HOA has budgeted for the acquisition of the Irrigation Management System.

Not only has the system alerted the District's irrigation technicians to numerous broken heads but it has saved the District many thousands of gallons of water resulting from main line breaks. In one particular case the District's system reported a water main break at the North Open Space Park that was leaking 281 gallons per minute. This leak occurred at 3:10 AM on a Saturday morning and ran for 2 minutes before being automatically identified as a leak and shut off by the Irrigation Management System. It is very possible that because of the location of this leak and the time and day of the leak, it could have gone undetected for a minimum of 24 hours. Had this leak gone undetected the District would have wasted 404,640 gallons of water in a 24 hour timeframe. This amount of water is roughly equal to one month's water use for 80 households.

Meter readings were provided by the District for each irrigation zone for 2008 (partially irrigated with and partially irrigated without the Irrigation Management System) and 2009 (fully irrigated with the Irrigation Management System). Detailed meter data are available in Attachment B for reference. The District used 31% less water during 2009 at the Irrigation Management System irrigation zones. The amount of water savings attributable to the installation and operation of the Irrigation Management System is difficult to assess from meter readings alone due to the interrelated nature of irrigation needs and climate differences from year to year.

Irrigation reports from the Irrigation Management System were also provided by the District for the 2009 irrigation season to better represent water savings throughout the system. Detailed water management reports (available in Attachment C) show that the system's water needs have been previously budgeted based on historic ET rates. The new system determines actual ET rates using information from the CALSENSE weather station and adjusts the gallons needed accordingly. Table 3 shows that the Irrigation Management System resulted in 66% less actual gallons used than were budgeted for the actual climate conditions. This amounted to over 20 million gallons of water saved at the CALSENSE locations.

Table 3 Water Savings from CALSENSE Irrigation System – 2009

Location	Budgeted Gallons[1]	Actual Gallons	Savings Gallons	Percent Saved
South Open Space	6,013,677	2,395,765	3,617,912	60%
Coyote Ridge Lower	5,194,196	1,350,708	3,843,488	74%
Retreat	6,522,018	1,967,440	4,554,578	70%
North Open Space	6,263,275	2,313,601	3,949,674	63%
Coyote Ridge Upper	3,926,254	1,553,665	2,372,589	60%
Daniels Gate	2,288,411	564,416	1,723,996	75%
TOTAL	**30,207,831**	**10,145,595**	**20,062,237**	**66%**

(1) Controller entered budget adjusted based on actual ET