

## **Denver Parks Irrigation System Inventory Project**

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### ***Introduction***

Denver Water and Denver Parks jointly funded the research and development of an irrigation system replacement plan for the entire Parks system. A RFP was released October, 2001, and a contractor was selected December, 2001. The replacement plan report was completed July, 2002. Denver Parks has 2258 acres of irrigated parkland. Some of these irrigation systems are over 40 years old and have never been renovated or replaced. Over 222 acres of these irrigated parks are still watered with quick-couplers or manual valves. Denver Parks uses close to 2 billion gallon of water annually to irrigate these parks. This paper outlines all the methods used to collect and analyze the condition of the systems, the criteria used in the analysis and the final recommendations from the contractor.

### ***Request for Proposals***

Denver Water developed a RFP in October of 2001 that was sent to seven irrigation/engineering consulting firms in the Denver area. The language from the RFP is inserted below.

#### ***Objective***

Denver Parks needs a replacement plan developed for their Parks irrigation systems. This plan will include information on current systems, an estimation of the remaining life of each system, an estimation of replacement costs for the systems and the development of a 10-15 year Capital Improvement replacement plan. The final plan is due June 3, 2002.

#### ***Scope of Work***

Develop a report of existing irrigation systems for each of the Denver Parks locations. This excludes Mt. Parks and Golf Courses.

The final report must include the following information for each irrigation system:

- Overall analysis of current system
- Estimation of the remaining life of the system
- Costs and recommendations for replacement, if necessary

Develop a 10-15 year Capital Improvement replacement plan for Denver Parks' irrigation systems that are in need of replacement. This plan will be presented to the Denver City Council at a date not yet determined.

Collection of the following information will be necessary to determine the condition of each system:

1. Date of installation
2. Date of major renovations or system improvements
3. History of problems, repairs and leaks
4. History of water use

(The information can be obtained by performing record searches, field tests and interviewing Denver Parks' employees.)

Determining the type of system and the condition of the six irrigation components listed below will be necessary to develop a plan for replacement:

1. Backflow prevention
2. Water meter
3. Mainline
4. Valve clusters
5. Valves
6. Controllers

The proposals were due Friday, November 23<sup>rd</sup> by 10:00 am. We received two proposals, but only one was qualified to complete this project in the short time frame.

### ***The Proposal***

The selected contractor was a team of two engineering firms, Aqua Engineering and Black and Veatch. Their project approach is outlined below.

The scope of work was divided into five tasks:

**Task 1.0** was the kick-off meeting. The goal of the meeting was to set the strategy and establish replacement priorities for the study.

**Task 2.0** included the interviews with the maintenance technicians in all eleven Park Districts within Denver. The park employees were to provide information on the existing conditions at each of the park sites. This information included information on the condition of all the main components of the system and repair history.

**Task 3.0** was the development of a database to collect and sort all the information collected during the interviews.

**Task 4.0** was the development of a capital improvement replacement plan that would become part of the final report.

**Task 5.0** included the preparation of the final report and presentations to the Denver City Council and/or other interested parties. The proposal was accepted and Denver Water developed and signed a contract with the two Engineering firms in December 2001.

### ***Project Approach***

During the kick-off meeting dates were set for District interviews, monthly meetings and final report completion. The Owners (Denver Water and Denver Parks) had monthly meetings with the Consultants to keep the project on track by answering questions, giving direction and gathering necessary data.

The Maintenance District interviews were scheduled starting in January 2002. A questionnaire was sent to each Maintenance District outlining information that was to be collected prior to the interviews. A sample of the type of questions was included in the questionnaire. Each interview took a day to complete and these were scheduled from January through March. The purpose of the interviews was to identify maintenance problems with the irrigation systems and to get an understanding of the excessive water use.

The collection of data and development of the database was the main portion of this project. All the data collected at the interviews and by the Owners had to be entered into an Access database that was constantly under development.

### ***The Report***

The report broke the information into the following major categories, and each of these will be discussed in detail.

- ◆ Interview Findings
- ◆ Database Documentation and Use
- ◆ Replacement Plan
- ◆ Replacement Costs
- ◆ Potential Water and Labor Savings
- ◆ Capital Improvement Replacement Plan
- ◆ Findings and Recommendations

### ***Interview Findings***

During the interview process, a common thread of problems became apparent. These problems either in combination or alone, account for the high amount of water used in the parks to keep them green. Some of the typical findings that were common among the Districts are listed below.

1. Age of the irrigation system – especially apparent in older park Districts.
2. Soil Conditions – Corrosive soils require replacement of metal components as often as every two years.
3. Mixture of sprinklers on laterals.
4. Vandalism.
5. Winter Sand – This creates a build-up along the curb edges which eventually blocks the spray from sprinklers.
6. Lack of adequate funding – Insufficient funds over the years have created additional repair issues due to them not being done properly in the first place i.e. the “Band-Aid” effect.
7. Breakage caused by new utility construction.
8. Failure to embrace new technologies.
9. Failure to embrace new equipment.
10. Abandonment of centralized irrigation control.
11. Continued maintenance budget pressure.

12. Employees are not given the time to repair and find obvious leaks.
13. Pressure from the public to have perfect quality turf in parks.
14. Failure to hold outside contractors accountable for poor quality workmanship.
15. Failure to repair broken components especially in medians.
16. Failure to properly design irrigation systems to site requirements.
17. Failure by Denver Parks planning group to get input from maintenance technicians.
18. Maintenance technicians are not given water consumption information to know how much water they are using.

### ***Replacement Plan Priority Assignments***

A priority assignment of 1-4 (1 being the highest ranking) was given to every irrigated site.

#### Priority 1

Sites that fell into priority 1 were in need of immediate replacement to improve irrigation efficiency and reduce labor requirements. The criteria used to determine if a site was a priority 1 are:

- ◆ Perceived useful life left in system is less than 5 years.
- ◆ Original date of irrigation system installation was more than 25 years.
- ◆ Date from last complete or partial renovation is more than 15 years.
- ◆ Manually operated systems
- ◆ Large and/or highly visible site.
- ◆ High water use or implied inefficient water use.
- ◆ Persistent, recurring, documented problems.
- ◆ Mixed equipment on site.
- ◆ Site identified as high maintenance

#### Priority 2

Sites that fell into priority 2 will be replaced in 5 years. The criteria used to determine if a site was a priority 2 are:

- ◆ Perceived useful life in the system is less than 10 years.
- ◆ An older system, more than 15 years old, that is in fair condition.
- ◆ A system that has been partially renovated in the last 10 to 15 years.
- ◆ Larger or visible or highly used sites.
- ◆ High water use or implied inefficient water use.
- ◆ Mixed equipment on site.

#### Priority 3

Priority 3 systems are to be replaced in third 5 years of the program. These are systems that have more than half of their useful life remaining. The criteria used to determine if a site was a priority 3 are:

- ◆ Perceived useful life left in system is less than 15 years.
- ◆ Newer system, less than 15 years old.
- ◆ Minor operational problems.

- ◆ Lower water use on site.

Priority 4

Priority 4 includes systems that have been built in the last 5 years. The criteria used to determine if a site was a priority 4 are:

- ◆ New irrigation systems.
- ◆ Perceived useful life left in system is more than 20 years.
- ◆ Original date of irrigation system installation is less than 5 years.
- ◆ Sites that have low water use.

The table below shows how many sites fell into each priority for all the Districts.

Maintenance District	Number of Priority 1 Sites	Number of Priority 2 Sites	Number of Priority 3 Sites	Number of Priority 4 Sites
Northwest	4	17	8	2
Southwest	2	4	13	0
East	8	8	11	4
Central	14	10	15	1
Montclair	13	3	6	2
Northeast	6	4	14	1
Southeast	8	9	6	1
South	7	6	6	2
West	8	14	14	2
Platte	6	2	7	4
Lowry	2	0	2	9
<b>Totals</b>	<b>78</b>	<b>77</b>	<b>102</b>	<b>30</b>

The number of acres per District is as follows:

Maintenance District	Acreege of Priority 1 Sites	Acreege of Priority 2 Sites	Acreege of Priority 3 Sites
Northwest	130	80	80
Southwest	5	20	120
East	240	40	10
Central	160	30	20
Montclair	90	20	60
Northeast	20	40	50
Southeast	60	70	80
South	190	40	30
West	170	90	60
Platte	20	10	40
Lowry	30	0	30
<b>Totals</b>	<b>1,115</b>	<b>440</b>	<b>580</b>

The estimated replacement costs are as follows:

<b>Maintenance District</b>	<b>Cost of Priority 1 Sites</b>	<b>Cost of Priority 2 Sites</b>	<b>Cost of Priority 3 Sites</b>
Northwest	\$3,204,000	\$2,883,000	\$2,001,000
Southwest	\$146,000	\$635,000	\$3,689,000
East	\$5,892,000	\$1,083,000	\$421,000
Central	\$4,744,000	\$914,000	\$647,000
Montclair	\$2,903,000	\$468,000	\$1,567,000
Northeast	\$482,000	\$1,503,000	\$1,380,000
Southeast	\$1,677,000	\$1,851,000	\$2,072,000
South	\$4,816,000	\$1,032,000	\$616,000
West	\$4,239,000	\$2,356,000	\$1,939,000
Platte	\$488,000	\$228,000	\$1,140,000
Lowry	\$913,000	\$0	\$790,000
<b>Totals</b>	<b>\$29,504,000</b>	<b>\$12,953,000</b>	<b>\$16,262,000</b>

The total cost for priorities 1, 2, and 3 is \$58,719,000.

### ***Capital Improvement Replacement Plan***

The report identified several future funding options. They are as follows:

1. General Obligation Bonds. The City and County of Denver occasionally issues general obligation bonds to finance major capital improvements. A portion of the proposed irrigation system improvements could be financed from the next bond issue. The timing of this issue is uncertain but may occur within the next five years.
2. Certificates of Participation. The City and County of Denver typically funds its capital projects using certificates of participation. This funding instrument is a capital lease backed by a pledge of City and County assets. The certificates usually have a 15-year term and are currently being issued at annual interest rates ranging from 4% to 5%. In order for this to be a viable instrument, a determination of appropriate collateral assets will be needed.

3. Conservation Incentive Programs. Denver Water provides incentives for certain conservation programs. The ability and applicability of this program to funding Denver Parks irrigation system improvements is being evaluated.
4. State Revolving Fund loan. The Colorado Water and Power Development Authority provide low-interest loans to eligible utility improvement projects. Loans typically have a 20-year term and currently are being issued at annual interest rates between 3% and 4%. The eligibility of Denver Parks irrigation improvements for these funds is being evaluated.
5. Permit Fee Increases. The highest irrigation requirements are generally associated with athletic fields. There is a nominal fee currently charged to users of these facilities. Park user fees for athletic fields might be increased to help offset costs of irrigation system improvements.
6. Grants for Sustainability. The Poudre Valley School District in the northern Front Range region has obtained a sustainability grant to fund irrigation projects. This may be a viable funding option for Denver Parks irrigation system improvements.

There are three funding sources that are available to the Parks and Recreation Department. The first is CIP monies (Capital Improvement Program). Parks receives annually \$150,000 for irrigation infrastructure improvements. If this level of funding continues for the 15 years of the study, it will total \$2.3 million. The two other sources of funding that became apparent through data analysis, water and labor savings.

The total potential water savings for all 257 sites is about 325 million gallons annually. At the current water rate of \$1.09 per thousand gallons, the potential water cost savings is over \$350,000 per year. The total direct annual labor cost associated with repair and maintenance of the irrigation systems is \$1,372,400. If a 60% reduction in the labor cost were realized by the improvements to the irrigation systems, as suggested by the maintenance technicians, the potential annual labor savings is \$823,000. The 60% reduction in labor costs may not be achievable. Conservatively, the analyses indicate that a 40% reduction in labor costs or an annual savings of \$550,000 is a more reasonable and achievable savings

### **Total Savings**

The total potential annual savings in water and labor costs is \$900,000. Obviously, it is not possible to realize the full annual savings immediately for the 15-year project. All the improvements must be completed before the full annual savings can be realized. But, as the improvements are made some savings will be realized.

To estimate the potential savings realized during the 15-year project, it is assumed that 1/15 of the total savings is realized for each year of the project and that the savings is cumulative. For example, 1/15 of the potential annual savings is \$60,000. Therefore, in year 1, the potential annual savings is \$60,000. In year 2, the potential annual savings is \$120,000 and the cumulative savings is \$180,000. By year 15, the full potential annual savings of \$900,000 will finally be achieved and the cumulative savings that has accrued during the course of the project is in excess of \$7 million. The growth of the potential savings over the course of the project is illustrated in Figure 1.

It should be noted that these savings do not account for increases in the cost of water and inflation of labor cost over the 15-year project.

## **Summary**

Interviews with Maintenance District irrigation technicians identified problems that affect the amount of water applied and the level of water conservation possible. The age of the existing irrigation systems was the primary problem identified.

Of the 287 irrigated sites, 257 sites covering 2,135 irrigated acres are in need of improvements in the next 15 years. Priority assignments were made to these 257 sites to understand the phasing of potential improvements and the probable construction costs.

Priority 1 sites are in immediate need of replacement to improve irrigation system efficiency, and reduce water wastage and labor requirements. The irrigation systems in this category would ideally be replaced in the first 5 years of the program. The costs for the Priority 1 sites are over \$29 million. Priority 2 systems will be replaced in the second 5 years of the program. These systems are old but are currently more efficient than those in Priority 1. The costs for the Priority 2 sites are almost \$13 million. Priority 3 systems are to be replaced in the third 5 years of the program. These systems have more than half of the useful life remaining and are currently reasonably efficient. The costs for the Priority 3 sites are over \$16 million. The total replacement costs would exceed \$58 million in 15 years.

The total potential water savings for all 257 sites is about 325 million gallons annually. At the current water rate of \$1.09 per thousand gallons, the potential water cost savings is over \$350,000 per year.

The annual direct labor cost associated with repair and maintenance of the irrigation systems is \$1.37 million. If a 40% reduction in labor cost were realized by the improvement of the irrigation systems, the annual labor savings is \$550,000. The total annual savings resulting from improvements to the irrigation systems is \$900,000.

There are three probable funding sources that are applicable to the Plan: City and County Parks and Recreation Department capital improvement program, savings in water costs, and savings in labor costs. These sources are projected to generate a total of \$10.1 million during the study period. However, this amount is not adequate to meet irrigation system capital costs of \$58.7 million, creating a shortfall in funds that accumulates to \$48.6 million at the end of the study period. Additional options for funding the remaining \$48.6 million of irrigation system improvements include general obligation bonds, certificates of participation, conservation incentive programs, state revolving fund loan, permit fee increases, and grants for sustainability.

It is recommended that Denver Parks develop an ongoing funding mechanism that is realistic for the 2500 acres (and growing) of irrigated area. The current \$150,000 per year falls far short of the funds needed to properly maintain the systems.