COOLIDGE REGIONAL PARK PROJECT

PROGRESS REPORT

No. 2

Prepared by

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With Contributions From

COOLIDGE REGIONAL PARK INTERDISCIPLINARY TEAM

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SUMMARY

In the first phase of the project, a design for the proposed Coolidge Regional Park was completed and accepted by city officials. Results of the initial investigation are reported in Gary Small's 1973-74 progress report.

In this phase of the project, a detailed planting plan and irrigation design were completed along with cut and fill calculations. Reclamation of the soil is also discussed.

For purposes of irrigation, the park was divided into three zones; the desert zone, the buffer zone, and the recreation zone. Two alternative irrigation plans are included for both the buffer and recreation zones. Irrigation systems for the two zones were designed to be independent because of the differences in topography and also to allow installation of the systems during different phases of construction. Rough cost estimates are included to help city officials decide which combination of systems best fits their needs.

Reclamation of the soil depends on soil conditions after construction and prior to the final planting. A green manure crop has been recommended for the first year. At the end of that year the crop will be disced under and the basins releveled.

Further studies should be made to determine present groundwater quality and the effects irrigating with sewage effluent has on that quality.

INTRODUCTION

On October 5, 1973 an agreement was entered into by the University of Arizona and the City of Coolidge to develop plans for a proposed Regional Park. Dr. L. G. Wilson and Gary Small, along with other committee members, collected data which were presented in the report entitled Coolidge Regional Park Project Progress Report, by Gary Small.

The report centered mainly around possible water sources for the irrigation of the park. It also included background information about the project including geological, hydrological, and soil characteristics of the proposed park site. The summary states:

> Before any additional drawings can be made, meetings with committee members are necessary to coordinate ideas on park designs, soils data, irrigation systems and turf grass management.

Since the report, a tentative design for the layout and facilities to be included in the park was agreed upon.

The purpose of this paper is to provide a continuing report on the progress of the Coolidge Regional Park Project, with particular reference to the design of an irrigation system.

OBJECTIVES

The objectives of this phase of the project were to: (1) Complete a planting plan for the entire park; (2) design an irrigation system for the park based on information previously collected; and (3) determine the best method for reclamation of the soil.

PROCEDURE

Information collected during this phase of the project includes reports, correspondence, maps, etc.

The following people contributed their expert ideas and suggestions:

Al Halderman - Agricultural Engineering Specialist
Cooperative Extension Service, University of Arizona

Dr. Gordon Johnson - Agricultural Chemist
Dept. of Soils, Water and Engineering, University of Arizona

Dr. Dennis Kasper - Assistant Professor
Dept. of Civil Engineering, University of Arizona

R. D. Light Jr. - Sales Engineer
Rain for Rent, Ariz. Inc.

Carla McConnell - Student Landscape Architect
Dept. of Landscape Architecture, University of Arizona

Walt Parsons
USDA, Soil Conservation Service

This report is based on the information provided by the above sources.

PARK DESIGN

The park is to be located at the old airfield on Coolidge Ave. and Kenworthy Rd. It will be just north of the sewage treatment plant (see Plate 1. Park Design).

Two main complexes were located at separate entrances to avoid heavy traffic, both at the entrances and through the main picnic areas. This arrangement also serves to separate large group gatherings from family and individual outings. The west complex includes individual and small group sports, such as tennis and basketball, while the east complex has facilities for team sports such as softball and Little League baseball. The center portion has a large open field for casual sports and picnics.

Carla McConnell, the student landscape architect who designed the proposed park, has recommended that three distinct vegetative zones be used. Each zone would serve a different useful purpose. These zones, as described below, can be clearly seen in Plate 9. Cut/Fill Requirements.

1) Desert zone:

The desert zone will be left in more or less its natural state. It will have bike and hiking trails and require very little maintenance once established. The road medians will be considered as part of the desert zone.

It should be noted that the park designer recommends planting of Athel, Russian olive, Arizona Cypress, and Smoke trees in small areas of this zone. The required irrigation for these trees is not discussed in this report, since it is thought that they could be replaced by native species.

2) Buffer zone:

The buffer zone separates the park from the sewage treatment plant. It hides the treatment plant from the public and adds to the aesthetic quality of the park. It will consist of three elongated two-foot mounds with trees spaced at about fifteen-foot intervals on either or both sides of the mounds.

3) Recreation zone:

The recreation zone, or main park area, consists of approximately forty acres of recreational facilities such as tennis and basketball courts, baseball diamond, swimming pool, picnic areas, etc. It will have a Bermuda grass cover with scattered shrubs and trees.

PLANTING PLAN

The planting plan as shown in plates 2 through 7 is self-explanatory. The plants were chosen for their durability and aesthetic quality.

It was determined that the salt content of the soil increases with depth. Therefore, special precautions will have to be taken during planting. The holes should be as large as possible. A 5-gal. tree should have at least a 3-ft. diameter hole, 3-ft. deep. The soil taken from the hole should be discarded and replaced by better quality soil and organic matter and gypsum should be mixed in with the replacement soil.

Soil analyses subsequent to completion of the planting plan indicate that the following species should be replaced by other species on the list (Plate 2); Smoke tree, Russian Olive, Carolina Laurel Cherry, and Silk tree. The Eucalyptus species are questionable.

IRRIGATION DESIGN

DESIGN PARAMETERS

The design of an irrigation system for the park depended upon three major factors; the park design and planting plan as described above, the available water supply, and the initial cost. The water supply and initial investment are discussed below.

Water Supply - During previous studies it was determined that the use of sewage effluent for irrigation would be feasible if certain conditions and requirements were met. The quantity and quality of the effluent were the main factors in question.

When the City of Coolidge completes its sewer system, the new treatment facility will be used by approximately 8,000 people. Assuming that each person will generate 100 gpd, a total of 0.80 mgd will be available for irrigation. At that rate there should be an adequate supply of water to irrigate the park. However, during the peak use period, the park will require a majority of the 0.80 mgd, and irrigation of the surrounding farmland with the effluent will probably have to be discontinued.

The effluent must also meet the requirements set by the State Dept. of Health. In this particular case, a 20-day detention time and less than 200 fecal coliforms per 100 ml of effluent is required. Therefore, the pond storage will have to be large enough to accommodate the irrigation needs of the park, as well as the 20-day detention period.

Dr. Dennis Kasper wrote the following concerning chlorination of irrigation water.

"According to the new sewage treatment plant plans dated Nov. 16, 1973, the total volume available for satisfying the detention period requirement is approximately 16 million gallons which results in a theoretical average detention period of 20 days at a flowrate of 0.8 mgd. This 16 million gallons includes the polishing ponds (3 MG), and holding ponds number 1 (4 MG) and number 2 (9 MG). The detention period requirement will probably be satisfied the majority of the time if the three available ponds are operated in series and the irrigation intake is properly located in holding pond number 2. However, there will be periods during which the wind conditions cause direct short circuiting in th- final holding pond and the detention period will be reduced to approximately 10 days.

The fecal coliform requirement of 200 per 100 ml is more critical than the detention requirement in assuring absence of pathogenic bacteria in the irrigation water. The effluent of the chlorine contact chamber will meet this bacterial requirement. However, it is questionable that the irrigation water will contain less than 200 fecal coliforms per 100 ml at all times since the chlorination operation is followed by more than 15 days of detention in the holding ponds. The aggregated algae and other suspended solids in the polishing pond effluent may shield bacteria from the action of the chlorine. Bacterial tests performed on the effluent of the chlorination chamber should satisfy the requirement since adequate time has not passed for the release of the bacteria into solution.

During the detention period in the holding ponds coliforms can be released from the suspended solids and the coliform concentration as determined by the standard bacterial tests will increase. This possible increase might be offset by the gradual die-off of fecal coliforms with time. Input of fecal coliform contaminated water into the holding ponds can also occur during chlorine cylinder replacement or during periods of chlorination equipment failure. Once the holding ponds are contaminated, months may be required for the natural die-off to reduce the coliform concentration to the specified level.

If bacterial tests of the irrigation water fail to meet the state requirements it will be necessary to chlorinate the holding pond effluent immediately before use. Generally effluents from holding ponds having anaerobic sludge beds contain some ammonia which forms combined residuals with the chlorine. In view of the fact that combined residuals do not have great disinfecting qualities and due to the presence of high concentration of suspended organics, ensured reduction of the fecal coliforms of 200 per 100 ml will require a minimum combined residual of 1.0 to 1.5 mg/l depending on pH and temperature, and a minimum chlrine contact period of twenty to thirty minutes. The flow period within the irrigation transmission pipes can be considered part of the required contact time.

Depending on the location of the irrigation intake it will probably be possible to use the sewage plant chlorination facilities and simply pipe the chlorine solution to the irrigation water contact basin. Operational experience might even eliminate the need for chlorination between the polishing and holding ponds."

<u>Initial Investment</u> - During conversations with committee members it was determined that funding for the park is extremely limited. Therefore,

the initial investment should be kept as low as possible.

Gary Small's report states that,

> For actual construction, the City of Coolidge will join forces with Central Arizona College...to provide a training area for underpriviliged students...

Land leveling for flood irrigation, which will be used for the major portion of the park, will enable students to receive training in earth-moving and operation of heavy equipment. This free labor and equipment will also greatly reduce the expense to the City.

IRRIGATION PLAN

There are several possible methods of irrigation for this project. The best method in this particular case depends on the amount of money available for the initial investment and the amount of labor that will be available after the system in installed. The final decision can only be made by City officials. Therefore, several alternative solutions to the problem are discussed in this paper.

Each zone of the park will require a different type of irrigation system due to the differences in topography and vegetation. These separate systems will allow installation of each system during different phases of construction.

Desert Zone

Cut/Fill Requirements - If not other source of fill is available, the desert zone may be scooped and swailed. This would provide a limited amount of fill. However, it would also destroy any existing natural vegetation.

If the area must be scraped, new tree locations should be marked, and the ground should be sloped down toward them from all sides. Doing so will provide a large catchment basin. These basins should increase the amound of water available to the trees.

Irrigation Plan - The desert zone will receive no water other than natural rainfall.

Buffer Zone

Fill Requirements - The buffer zone will require approximately 16,500 cubic yeards of fill to form the three mounds (see Plate 8. Grading Plan). The fill will probably have to be obtained from an outside source.

Irrigation Plan - The buffer zone will be composed of trees at different elevations. On the sloped areas, each tree will have a well, or basin. On fairly level areas, small groups of trees can be surrounded by larger basins. Basins surrounding trees near the road should be designed to catch runoff from the road wherever possible.

After the trees are planted, the basins should be flooded weekly for about two years, or until the watering requirements change. The water for flooding will be supplied by a small pump located at the north end of holding pond No. 1. Delivery from the pump to the trees can be accomplished by either of the following methods.

The first method involves low initial costs with high operating costs. A 2" PVC line can be run from the pump site to the nearest section of mounding. From that point the line branches to the east and west and runs near the center of the mounds until it reaches the end points. A 3/4" hose bib should be located at about 100-foot intervals, starting at the "T" and working both directions (see Plate 10. Buffer Zone Irrigation Plan No. 1). The basins could then be filled by turning on the pump and connecting a 75-foot hose to the nearest spigot.

The second method, recommended by Mr. Halderman, involves a greater initial cost, but a very small operating cost. Again, the water would be supplied by a small pump located at the north end of holding pond No. 1. A 1 1/2" PVC line will feed each of eight sections. Each section will be composed of 1" PVC or 1 1/4" polyethylene pipe, which intersects the basin of each tree (see Buffer Zone Irrigation Plan No. 2, sheets 1 and 2). Within each basin, an IBG plastic nozzle (available through The Swanson Co., Phoenix) will be threaded into the pipe. 180^{0} nozzles should be used at a water pressure of 20 psi. A watering schedule should be established after the system is installed; however, probably no more than one of the eight valves should be turned on at one time and each should be operated for about two to four hours per week during the summer while the trees are small. As the trees become larger, they will need more water and water application will have to be increased.

If 1" PVC is used in place of the 1 1/4" polyethylene the cost may be reduced somewhat. The PVC would have to be drilled and tapped wherever a sprayhead is to be located, whereas the polyethylene only requires a punched hole. It may be necessary to provide for drainage of the PVC to prevent splitting during freezing weather. End drain plugs would also provide a means of flushing microbial growth from the system.

<u>Pump Size</u> - Each plan outlined above requires a slightly different pump. The first plan, using spigots, requires a pump that will deliver 15-20 gpm at 45-55 psi. The second plan using sprayheads requires a pump that will deliver 13 gpm at 35 psi.

<u>Cost</u> - Plan No. 1 requires about 2600 ft of 2" PVC with 24, 3/4"

hose bibs. The total cost, not including installation or power hookup for the pump, will be about $1600 at today's prices (see Table 1).

Plan No. 2 uses 225 small sprayheads and requires 1920 ft of 1 1/2" PVC and 5080 ft of 1" PVC. The total cost of parts for this system would be about $1800 (see Table 2). If 1 1/4" polyethylene were used in place of the 1" PVC the cost would be slightly more than $300 greater, or about $2100 total. That is, if the polyethylene is available.

The main difference in price between the two systems is the cost of installation. Plan No. 1 requires about 2600 ft of ditching, whereas Plan No. 2 requires about 7000 ft. Estimates should be obtained from local contractors to determine exact differences. However, if equipment and labor can be obtained from Central Arizona College, the difference in the initial cost of the two systems would only be from $200 to $500.

Recreation Zone

Cut/Fill Requirements - The recreation zone is to be flood-irrigated, therefore, it should be perfectly flat and level in order to accommodate uniform percolation and wetting. There is about a five-foot drop in elevation from the east end of the zone to the west. Using 1.5 ft as a maximum cut, the zone was divided into three levels with a difference of about one ft in the finish elevations (see Table 3). The necessary cuts and fills were calculated using a cut/fill ratio of 1.25 to account for soil compaction (see Plate 9. Cut/Fill Requirements). No allowance was made for roads, pathways, tennis and basketball courts, etc. Fill for these areas can be taken from the desert zone, or from outside sources as acquired.

Table 1

PARTIAL COST AND PARTS BREAKDOWN OF
BUFFER ZONE IRRIGATION PLAN NO. 1

AMOUNT	ITEM	PRICE
2600 ft	2" PVC Class 160	$ 927.00
48 ft	3/4" Galvanized pipe	72.00
24	3/4" Hose bibs	72.00
24	PVC 2" to 3/4" Threaded reducers	15.00
106	2" PVC Connectors	52.00
24	2" PVC T's	26.00
1	1 1/2 h.p. Barnes Model 165U pump	273.00
15 ft	Suction hose and screen	Approx. 100.00
	Total	$ 1,537.00

Prices provided by Kerona, Inc. and Ronstadt's Hardware. All prices subject to change.

Table 2

PARTIAL COST AND PARTS BREAKDOWN OF
BUFFER ZONE IRRIGATION PLAN NO. 2

AMOUNT	ITEM	PRICE
1920 ft	1 1/2" PVC	$ 453.00
5080 ft	1" PVC	740.00
254	1" PVC connectors	52.00
96	1 1/2" PVC connectors	30.00
68	1" PVC T's	14.00
7	1 1/2" PVC T's	6.00
77	1P PVC caps	18.00
10	1" 90° PVC L's	4.00
22	1" 45° PVC L's	10.00
8	Valves	Approx. 35.00
3	1 1/2"-1" PVC reducers	Approx. 5.00
230	Spray heads	37.00
1	Pump, 1 h.p Jacuzzi Model DM1	193.00
15 ft	Suction hose and screen	Approx. 100.00
	Total	$ 1,697.00

Prices provided by Kerona, Inc. and Ronstadt's Hardware. All prices subject to change.

Table 3

LAND LEVELING DATA

LEVEL (#)	AREA (ac)	FINAL ELEV. (ft)	VOLUME CUT (yd^3)	VOLUME CUT (yd^3/ac)
1	16	101.3	5,200	325
2	14	100.4	5,400	386
3	11	99.5	6,800	618

With a Bermuda grass cover and improved infiltration rates, a maximum area of four acres can be flooded efficiently with the flow rate selected. Therefore, each of the three levels should be further split, using raised pathways as dividers wherever possible and 6" to 8" berms where no path is available (see Plate 10. Recreation Zone Irrigation Plan). As soil conditions improve, reduction of the size and shape of basins may be necessary. Where a pathway divides part of a flood basin, small culverts should be installed to allow free movement of water.

Twelve-inch culverts should be installed under the roads to allow drainage of flood-water or excess irrigation.

Irrigation Plan - The vegetation in the recreation zone will be composed of a Bermuda grass cover with scattered shrubs, bushes and trees. Watering of these plants will be accomplished by flooding through portable gated pipe. The water will be supplied by a pump located at the east end of holding pond No. 2 through 2270 ft of 12-inch asbestos cement pipe. The pipe will run underground, east from the pump to the road, branch to the south for irrigation of surrounding farmland during off-peak periods, and north toward the recreation zone. A valve will be required to regulate the direction of flow to the park or farmland. From the valve, the 12-inch pipe runs north, parallel to Kenworthy Road until it comes within 200 ft of the east entrance of the park. At that point it bends northwest toward the fork in the park road (see Plate 10. Recreation Zone Irrigation Plan).

Two risers with valves and adapters will be used to tie into the gated pipe. One will be located in level 1 and the other in level 2.

A total of 1300 ft of 8" gated aluminum pipe will be used to deliver water to the basins. Two 45^{o} elbows, one 90^{o} elbow and one "T" will also be required to make the seven setups shown in Plate 10. The setups shown each require from 1000' to 1300' of pipe. Therefore, only one setup can be made at a time. As the basins are filled in one section, the pipe is moved to the next one until all the basins are filled. The gates on the pipe should be opened in one basin at a time to allow rapid flooding and more even distribution of the water. Again a watering schedule shall be established after the system is installed, however, the basins should probably be flooded on a rotating basis over a 10-day period during the summer. Care should be taken to balance the amount of water being removed from the holding pond with the amount flowing in.

Gated aluminum pipe was chosen for delivery of the water throughout the park for the following reasons: 1) It minimizes initial cost because it can be moved to alternate locations; 2) it provides flexibility for adapting to any future changes in basin configuration; 3) the multiple outlets provide better water distribution within basins; and 4) it can be rented for use on a trial basis. If available, 8-inch by 20-ft sections, with a gate located five ft from each end, should be used. These sections will be fairly light and easily handled.

It is recommended that the pump and gated pipe be rented for the first year. If at that time it seemed that too much labor was involved in moving the pipe, an alternate system could be added on to the existing 12 inch AC pipe. The alternate system may require reducing the size of the basins and installing alfalfa valves in each one. The valves would have water supplied through a continuation of the existing 12 inch system. A larger pump will probably be required for the new system. Labor requirements would be reduced to opening and closing of the alfalfa valves.

Pump Size - The pump should be large enough to handle 1100 gpm at 21 psi. Table 4 contains one make and model that can be used.

The existing pump being used for farmland irrigation cannot be used for irrigation of the park because it is old and will be phased out within a short time. Also, its capacity is not large enough for the new system.

Cost - The proposed irrigation system requires 2270 ft of 12" AC pipe and about 1300 ft of 8" aluminum gated pipe. The whole system (not including installation) will cost about $25,000 at today's prices (see Table 4). The price of installation depends on the contractor chosen for the job.

RECLAMATION

Dr. Gordon Johnson, Agricultural Chemist on the committee, wrote the following recommendations concerning soil consideration:

"The soils in the Coolidge Regional Park area have been described in the 1973-74 Progress Report. Chemical analyses reported there (p30) and subsequent analyses indicate special tillage and soil management may be necessary during construction to reduce salinity and/or sodium hazards inherent to these soils. The salinity and sodium content generally increases with depth. Consequently, where soil is cut for construction of level irrigation basins, it may be necessary to incorporate steer manure (or suitable organic matter substitute) and gypsum. When deep cuts are made (7-12") surface soil (3-4") should be separated from subsoil and the surface soil replaced on the surface of fill areas. Since an appreciable amount of cutting and filling will be involved in the forming of basins for irrigation, a green manure crop, preferably barley is recommended the first winter. After the crop is grown and tilled under, the salinity

Table 4

PARTIAL COST AND PARTS BREAKDOWN OF
THE RECREATION ZONE IRRIGATION PLAN

AMOUNT	ITEM	PRICE
1300 ft	8" gated aluminum pipe	$ 2,730.00
2	8" 45° aluminum elbow	108.00
1	8" 90° aluminum elbow	54.00
1	8" aluminum "T"	72.00
2	8" aluminum end plug	48.00
2270 ft	12" AC pipe	15,685.00
2	12" iron ring tite "T"	427.00
1	12" 60° ring tite elbow	118.00
2	12" 90° ring tite elbow	266.00
2	12" gate valve	821.00
2	8" alfalfa valves, Waterman type 5	64.00
1	8" hydrant with quick coupler	94.00
1	pump, Peabody-Barnes self priming, 1000-1200 gpm @25-28 psi with accessories and 30 h.p. drip-proof electric motor	2,555.00
1	control panel and magnetic starter	550.00
1	screen	22.00
10 ft	suction hose	130.00
	TOTAL	$ 23,744.00

Prices provided by Carlson's Utility Supply and Ronstadt's Hardware, both of Tucson, and Rain for Rent, Arizona, Inc. of Chandler. All prices are subject to change.

and sodium hazards should be reevaluated.

In order for accurate recommendations to be made regarding use of soil amendments, additional soil samples should be taken after all land forming is completed and just prior to preparation for seeding of bermudagrass. Although bermudagrass is a salt tolerant grass, routine monitoring of soil salinity on an annual basis for the first several years is adviseable. Preparation for tree and shrub planting should include soil incorporation of steer manure and gypsum or soil sulfur."

Some considerations should be made concerning releveling of basins after a one year period to correct for soil compaction.

MONITORING PROGRAM FOR GROUNDWATER QUALITY

The Coolidge Regional Park will eventually utilize the entire sewage effluent discharge for the new treatment plant, via the irrigation schemes discussed herein. The observance of cascading water in irrigation wells in the area strongly suggests that groundwater recharge may occur during park irrigation. As a precautionary measure, therefore, it is recommended that the City of Coolidge develop a program to monitor the quality of groundwater in the environs of the proposed park. Such a monitoring program should include evaluation of total salt levels, including particularly nitrate concentration, and also fecal and total coliform concentrations. To be effective, this program should be initiated as soon as possible.

APPENDIX A

WATER APPLICATION CALCULATIONS AND ASSUMPTIONS FOR RECREATION ZONE IRRIGATION PLAN

By A. D. Halderman

Soil: Assume 4 ft. deep with 1.75 in/ft.
Total moisture capacity = (4) (1.75) = 7 in.
Assume 50% depletion which leaves
3.5 inches available for plant use.

Bermuda: Peak consumptive use = 0.35 in/day

Irrigation: (3.5 in.) (.35 in/day) = 10 days

Park Area: Assume 40 ac (actually <40 ac.)

Application Efficiency: Assume 85%
3.5 in/.85 = 4.1 in per application (gross)

Time Required: $Q = 1100$ gpm = 2.45 cfs
$d = 4.1$ in
$A = 40$ ac
$Qt = dA$; + = dA/Q

$t = (4.1)\ (40)\ /2.45 = 67$ hrs. = 8.4 days

Conclusion: A flow of 1100 gpm for 8 hours per day for 8 days will deliver 3.9 in to 40 acres. At 85% efficiency the net application is 3.3 inches. Assuming 10 days between irrigations, the daily supply would be .33 in per day.

This appears to be adequate. However, if necessary, irrigation could continue for more than 8 hrs per day.