Park Plazas Irrigation/Tree Survey - Master Copy

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Plazas Relampago, Lirio, Campanilla, Cordero

Scope of Work

Emergency Ecology Solutions (EES) was solicited by Park Plazas Landscape Committee Coordinator Nora Haskins and Richard White, Park Plazas HOA Director, to conduct an investigation, inventory, analysis and recommendation of potential upgrades to the irrigation system(s) /plant maintenance at the above four Plazas located at the SW corner of the PP complex.

This survey included the following:

1. an observation of the irrigation/tree watering system in the above units.
2. an inventory/analysis of the technical specifications of the irrigation systems currently in use;
3. an inventory of the trees/shrubs currently under irrigation in these Plazas;
4. an inventory of the remaining trees/shrubs in the units that were NOT under current irrigation;
5. an analysis of the current health of the trees/shrubs, both under irrigation and devoid of irrigation in the above units;
6. an identification via at least Genus or common name of both irrigated and non-irrigated trees/shrubs in the units;
7. a recommendation as to what improvements in both irrigation and plant protection/enhancements would be required to rescue, recover and rejuvinate existing trees/shrubs in these units.

Working Parameters of the Study

EES was provided with a number of various types of plat maps of the Plazas in question. Complete access to the landscape in the Plazas was given. EES was given complete access to the persons responsible for the management of these Plazas and their landscape systems. The analysis was based upon the following:

Direct access to the Plazas;

Interviews with several persons who are either residents of the Plazas or have maintenance responsibilities for these Plazas;

Interviews with persons who have managerial responsibilities for the landscapes/watering systems of these Plazas.

Description of the Analysis

EES walked the entire area of all four Plazas a number of times, visually inspecting, observing, measuring, identifying and mapping the various aspects called for in the Scope of Work, including location of existing irrigation boxes, meters, valves, lines and irrigation dispensing devices;

EES identified the various types of trees/shrubs to either common name or Genus of both irrigated and non-irrigated trees/shrubs;

EES measure the lengths and distribution of the existing irrigation lines/plants watered;

EES measured the potential extension of irrigation lines to important trees of interest that potentially will require watering via irrigation to ensure their survival and stable homeostasis;

EES identified 95 percent of all existing species in the units, and evaluated the current health of same;

EES analyzed the capability of the existing irrigation systems to adequately irrigate the existing plants under irrigation;

EES analyzed the capability of the current irrigation system to be modified, expanded and reworked to ensure adequate irrigation of both existing trees/shrubs AND important trees currently NOT irrigated via the existing system;

EES used existing maps and added detailed information of new plants and current plants existing with the units to those maps, including approximate locations.

Description of Findings

Irrigation System currently in Use;

The PP complex, including these four unit Plazas, is irrigated via the SF City domestic water system, supplying potable water to the landscape plants currently under irrigation. The standing head water pressure varies throughout the complex, but is fairly uniform in pressure, sustaining psi measures of 75 psi and greater to most meter connections. This psi requires a certain type of distribution for landscape plants without modification, and t**he PP complex was installed, at inception, with a flood bubbler style of irrigation** using dug 'wells' around plants that functioned as 'saucers' that held various quantities of water before overflowing.

The existing bubbler system is of a standard type that normally delivers between 0.5 - 16 gallons per minute (gpm.) This is a relatively large quantity of water to be delivered, across a relatively small area, into a soil type at PP that is mostly tight clays, a colloid that absorbs water slowly, but if delivered slowly will hold a substantial quantity of water for a prolonged period of time, due to the tight grouping of colloidal soil particles, which are the smallest soil particles know to exist on Earth.

Practically, this means that if water is delivered very slowly into the clay soil horizon, given the very increased volume of voids created by the small particles, it is highly possible that vast quantities of water could be stored within, and made available to plants that could send roots deep enough to tap the water.

But due to the bubbler system, which delivers a high quantity of water per minute, the total volume is low because the well fills very quickly, especially since the well is forty years old. All wells observed that were serviced with bubblers were seen to be inadequate for today's needs, being both too small in volumetric size via original construction, and having filled in with soil/debris for several decades.

This bubbler system started as adequate, but after about five to ten years became inadequate to maintain health and growth to the trees/shrubs it irrigated. This is due to the limits of the wells into which bubbler water was supplied, as the root systems of the plants grew beyond the reach of the wells ability to supply water.

It must be noted, as VERY CRITICAL, that the initial bubbler system, even if administered as correctly as possible, would fail to be adequate after a certain time.
Further, it is observed that an entirely different irrigation regime, called 'drip,' is installed into the bubbler system in some areas, especially the two street islands in the study area, and this combination, using the same water supply but involving two entirely foreign delivery mechanisms, **results in the 'drip' system being undersupplied by a factor of 30x to 320x. An impossible combination to deliver success.**

Delivery System Piping, Metering and Valve Controls

Irrigation systems utilize valves, a simple mechanism that either functions in an 'on' or 'off' behavior. For many years, these valves have been controlled, not manually, but by timed computers that are programmed to open and close the valves for various periods of time, set to deliver estimated quantities of water to the plants that need it.

These units in PP are controlled via one valve per unit, and the delivery piping begins with 1.5 in. line and drops to 0.75 in. line after passing through the control valve. The existing piping lengths vary somewhat, but average about 200-300 ft., excluding any 'drip' lines, and these drip lines average around 150-300 ft. where located.

The existing irrigation system covers, on average, only 33% of the mature, significant trees in each unit. Most of the unirrigated trees are junipers and pinon pine, both heirloom, native trees with a high aesthetic quality and greater natural immunity to both drought and pathogenic attacks.

The piping system, according to Oscar, the chief Maintenance Tech, is sized at 0.75 in. diameter across this 200-300 ft. length, along which between 16-34 plants are irrigated for each valve/line built. **Oscar has stated to EES that he must adjust the bubblers nearest the valves downward in quantity of delivery to ensure that the bubblers at the distal end can deliver enough water to fill the existing wells at the end of the lines.**

Why is this the case?

All piping creates resistance to laminar flow of water, due to friction, and further with each pipe fitting that occurs along any length, such as elbows, tees, couplings, etc. All of these are necessary when building a water supply line. A 0.75 in. water line, pressurized at any force, will lose about 22 psi for every 100 ft. This is important because if there is enough volume at maximum length, but inadequate pressure, then water cannot be delivered **at the rate the delivery device (bubbler or emitter or spray nozzle) is rated to produce.**

This is the problem Oscar encounters, and he has told me he runs each water cycle between 10-18 minutes, which fills the wells to the extent they can hold water.

There is ZERO piping to most of the mature trees in these units, unless individual homeowners have installed 'drip' lines from their own water source, and piped it outside their fence lines to irrigate some of the trees, shrubs, etc.

The total number of plants of significance, without irrigation, is 221, while the irrigated total is 96.

The Two Street Island's Irrigation

Drip Lines extend from the bubbler lines under the road into the islands. Most of the plants in these islands are water fed by 'drip' emitters that deliver water in gallons per hour (gph), **NOT** gallons per minute. But they are plumbed and timed into the gpm system of the bubblers, and therefore grossly underwater any plant compared to the bubbler that is installed on the same line. Ironically, there are some bubblers connected to these drip lines, so in some cases, trees are bubbled and receive more water than other trees located very close in proximity.

Many of the native specimen trees in the islands are not watered, a few are watered. There are several fruit trees in these islands, and they have done very poorly, even if irrigated, so EES suspects that they are both underwatered, or planted too deep and overwatered if bubblers are present. This situation is totally unacceptable.

The West Side of Relampago

This Plaza is only half sized. There is no formal vegetation on the west side (Rodeo Rd. side), and only a small amount outside the fenced areas **between the street/parking and the houses.** But the west side of the unit has many native trees that provide both screening and shade and beauty to the residences, and there are a fair number of good trees next to the parking/street that are not watered but give this unit its beauty. There is NO water line on this street side of the units to feed either the west outside or the near west side adjacent to the houses.

The Rodeo Rd. Entry adjacent to Relampago

There is irrigation along the entry side of the road from the Rodeo Rd. entrance up to the Relampago inlet road. Many trees are irrigated, and provide a visual and sound buffer along this street. The irrigation here is mixed bubbler/drip, and is in good to poor condition. One valve serves this road AND the first Street Island, which is all small drip line, but with some bubblers attached, which is a bad combination. There are 15 watered and 17 unwatered plants in this island.

The Unirrigated West Side of Relampago

There are 37 fairly large and about 10 smaller trees on the west side that are unirrigated, and there is no water service line on this side.

Lirio Irrigation System

The west side of Liiro AND the Inner Island are irrigated via a valve and meter located next to the road close to the Lirio Entrance. The line runs downhill along the back of Lirio on its west side, and another line runs under the road to the Island. The west line extends only about 40 percent down the driveway, but feeds the entire island. There are, exclusive the the 'drip' line in the island, twenty watered plants and 62 unwatered plants on Lirio's west side. The island has 12 watered and 14 unwatered plants.

Campanilla Irrigation System

This area, between Lirio and Campanilla, has many plants. A city meter and a valve service this area, located near the street directly between the east side of Lirio and the west side of Campanilla. The line runs down hill to the end of these units just above the walking path to the south. There are 26 watered plants, and 87 unwatered plants in this area.

Back Side of Campanilla Irrigation System

Because both Campanilla and Cordero share the common area here, EES has included it in this analysis. A second valve, located adjacent to the Campanilla valve, irrigates this common area, running under the driveway into Campanilla and extending SE to the common area between Cordero and Campanilla. It contains 16 watered and 32 unwatered plants.

Identification and Current Health of Existing Trees/Shrubs

Due to the season, most shrubs were unable to be identified, but constitute a small portion of the irrigated and almost none of the non-irrigated foliage.

As to the trees, they run the gamut of native and introduced trees most local nurseries carry. The dominant trees are junipers, both one-seed and Rocky Mountain varieties. Next are significant Pinon Pine, some well more than 200 years old. The largest junipers also are of this age. All the unirrigated trees have been evaluated as ‘fair’ in health, since SF has experienced only four average seasons of precipitation in the last 24 years, and our area is now in the worst drought in 1200 years.

No junipers were observed to be irrigated, and a very few pinons are irrigated.

Of the introduced trees, conifers of note include Austrian Pine, a close relative of the Ponderosa, but much easier to transplant. There are about ten large specimens of this tree, and since almost none are irrigated, they are rated ‘fair.’

The next most dominant trees are Silver Maples, a tree totally unsuited for our climate and soils, but due to irrigation, most have survived with some success, and most are rated ’good’ and some ‘fair.’ There are also a few Silver Poplars, native to NM, but a water loving tree that, in PP’s case, are thriving due to irrigation.

The next largest tree of significance is the Honey Locust, a very strong, drought resistant tree, but one that requires infrequent but deep watering to thrive. Most in this category are rated ‘good to fair’ and are irrigated, but inadequately.

In one location there are a small number of Atlas Cedars, a fairly strong, drought-tolerant tree that can become a shady specimen tree if cared for properly. They are irrigated, and in ‘good’ condition.

The last tree of import is the Russian Olive, not native, and not suited to our soils or climate. A number of these exist, with varying degrees of health, in the units of study, but none are rated as ‘good.’ A few are irrigated, and some are not.

There are some fruit trees, mostly apples or crab apples, and a few NM Olives, a native tree that thrives near water and must be irrigated to succeed. Most of these are 'fair' in condition, since they are 'drip' irrigated and therefore starved for water.

Phreatophytes (water-loving trees) at PP

The four Plazas contain Russian Olive, Siberian Elm, Silver Maple and a few other Maples that are not endemic to NM. These are water-loving trees, and require a huge amount of water to thrive. They also very aggressively seek out water, and when found, these trees will push out existing native trees, taking most of the available water away from drought-tolerant plants and killing them eventually.

EES has marked most of the Siberian Elms, which are not irrigated but have invaded watered areas, for potential removal. They can become good shade trees, if pruned well, and a few supply PP with both beauty and shade. In the long run, these trees are a threat to juniper, pinon and NM Olives, and since they are massive seed producers, can overwhelm any area, grow to some size, and then when water supplies dwindle, they regress, become filled with deadwood, and then die off.

Capability of Existing Irrigation System to Sustain both Existing Irrigated and Non-irrigated Trees into the Foreseeable Future.

The current irrigation system is woefully inadequate. Due to its conflicting duality of design - bubbler vs. drip - it continuously robs Peter to pay Paul, and both brothers are left short. Additionally, the very long line lengths, when coupled with a large volume demand per minute, leave many plants shorted for water due to decreased flow because of frictional flow loss. The valve timing to supply water to the bubbler wells **is incompatible with the drip lines** that are connected to the same bubbler line. Bubblers can only handle short time periods, but the drip lines require much longer run times to supply adequate irrigation for sustained health and growth.

Further, the very ancient flood irrigation, using dug soil wells, is inadequate to cover the increase in size and water demand of mature/growing trees, because the wells become too small to hold enough water and to distribute that water away from the bubblers, which are located very near the trunks of the trees.

There are many more un-irrigated trees than those receiving water - 96 vs. 221. When first built in the mid-1970s, the pinon/juniper forest was thriving due to adequate ambient water from the climate, but that train has left the station, and now these trees are in great peril. These trees also provide the most prolific screening, privacy, shade and camouflage/perching/nesting sites for our native birds.

Recommendations, including water volume/piping/delivery/timing changes, to rescue and recover existing natives and planted specimen trees and associated shrubs

Drip line modifications are needed to deliver extended area size/water volume needs of existing trees. Drip irrigation has many advantages, but also some liabilities when used to water large trees.

The major drawback is that these lines, in the case of PP, must be laid on top of the ground, and pinned using steel staples so they do not move or become dislodged from their locations. EES does not see this as a significant problem at PP, since there is little to no foot traffic where the trees are located. The reasons these new lines cannot be buried is that 1) they would require huge amounts of labor to dig and bury, and 2) the presence of near-surface roots from existing plants would lead to extensive damage, and more labor to deal with. These new drip lines are made of very durable materials, not easily chewed into or broken by shovels or squirrels, et. al.

They now come in a very mellow medium brown color, and blend in easily with the grass, dirt and shrubs.

Their emitters are pressure-compensating between 58-6 psi, which means they can deliver their rated water capacity across a very long length of line at variable psi ranges.
Because they have a rated and delivered capacity per hour, the amount of water applied can be calculated very precisely, as opposed to aerial watering via sprinklers or bubblers, which cannot be as precise, for several reasons that do not include drip delivery.

PP trees could be watered manually, and if done properly, would help the trees thrive. This would involve manual labor, equipment, materials and water connections that currently do not exist at PP.

To install drip is very labor-intensive. Each tree or tree grouping would require a line that circumscribes the tree(s) at about 60% of its dripline away from the trunk(s). Many trees grouped closely together can be treated as one unit, with one circumscribed line.

EES deduces that during the course of a full year, an extra 5-8 inches of precipitation would be needed to make PP trees flourish. At this time, SF is seeing ambient precipitation loss of around 6 in. per year, depending on where measurements are taken. In order to avoid death via bark beetle infestation, pinon pine need a water volume percentage in their cambium of 14% or above. In early 2022, thousands of pinon are dying due to lack of internal moisture, which renders their immune systems incapable of resisting the beetle burrowing into the cambium, killing the tree.

Juniper are hardier, but they are and have been showing serious stress in the last four years. ***By far, they are the most valuable tree in the high desert and must be saved where possible.***

In the four areas in question, the west side of Relampago, between Relampago and Lirio, the two street islands, between Lirio and Campanilla, and between Campanilla and Cordero, including the facing ends of all these units, EES estimates that about 6000 lineal ft. (lft) of drip will be needed, plus a solid delivery line of about 600 lft and solid black line extensions of about 500 ft. The 600 ft. is on the west side of Relampago to get water down from the paved street areas to the bottom island in the driveway.

The water pressure problem is real, but since drip will reduce the 'demand of water volume per hour' across pipe length, pressure drops from the existing delivery line can potentially be compensated for in all but one water valve zone - between Lirio/Campanilla. In this particular case, a smaller quantity of water dripped per hour via a smaller size emitter will be required, which will then lengthen the total run time of that water zone. It is also conceivable that a back pressure line at the bottom end could be installed to provide enough pressure to ensure desired volumes per hour.

A second way to make certain adequate water is available is to decrease the number of emitters per foot, and just increase the time needed to deliver water. The drip line EES recommends has several different line styles with varying emitter separations and different volumes per hour to handle this issue.

It is not known at this time, due to lack of information about which meter numbers service which Plazas, how much water is currently being used for irrigation. ***As a potential comparison,*** a 0.75 in. diameter line delivers about 16 gpm. There are 34 bubblers behind Lirio and feeding the second island. There is also a 225 ft. drip line with drip emitters located at each plant. If each bubbler emits 2 gpm, and the drip lines use 15 gph, then in 18 min., the longest Oscar irrigates any zone, a total of apropox. 1200 gallons will be applied to that zone, give or take 15%.

Oscar does his 1-3 times per week with the current system (not the example used above), depending on temperature and ambient precip., for six to seven months per year, but it is impossible to know, without metering, how much water is actually used per individual day of watering.

With 1500 lft. of drip line, plus existing drip line, at 18" spacing, about 1000 gph. will be used, plus the existing drip line of around another 300 gph, in one hour.. **But the square footage of the increased drip line watering will require about 2.5-3.0 times the water to supply six extra inches per year. So PP should anticipate a 2-3 times increase in water usage.**

To put down 2 in. of water under a tree with a 150 sq. ft. drip line, about 4-5 hr of drip time will be needed, using a 0.9 gph emitter spaced one foot apart.

This watering addition alters the entire watering cycle, which will be done 3-4 times per year, depending on local weather behaviors. A minimum of 2 in. of water, and up to three inches at some times, will be applied. A long, slow, deep watering is the best way to deliver a deep supply to the root zones. The longer any emitter is delivering water, the wider and deeper the cone of moisture becomes.

Note - this is an approximation. Installing reliable meters after the valve will show exactly how much water is being used per hour as long as the readings are done accurately.

EES did a quick determination of the materials needed to supply all the anticipated expansion of the four units. With no markup and a 38% discount, the materials cost is about 5-7k$. This is 6000 lft. of drip and associated piping parts, clamps and ground staples. That is to irrigate every tree except the Siberian Elms.

It is very difficult to estimate the labor times, since almost every tree or tree grouping is different, and will require differing applications. Each tree will be watered using the bubbler delivery line attachment, with bubbler removed and drip line attached and run out to every tree to be watered. If the trees are some distance from the connection, a solid line will be used so no water is dripped on bare ground or on any existing grass.

There are 315 total trees, and one solid line to be built, if chosen to do so. EES anticipates a minimum of 1-4 hrs per tree unit in labor time. Some will be longer, some shorter. Again, this is just an approximation. The solid line at Relampago will take about 2-3 days to complete.

Ecological Investments in Prolonged Health and Life of Existing and New Trees

Water, delivered in adequate supplies and timely fashion, will extend and improve the life of every tree or shrub. But water alone is NOT enough to take a tree’s genetics from potential to actual.

This is because no plant exists in a stable vacuum where nothing changes. The only constant is change, and Nature is the most ‘real time’ example of what combinations of contexts are needed to harmonize a group of individual plants into a micro-ecosystem.

It takes, in semi-arid to arid soils, about 1000 years to build one inch (1.0 in.) of ‘topsoil,’ which is a term that, when boiled down, means that for a millennium, all the leaves, needles, awls, bark bits and chips, blow-in debris, animal droppings and the like that accumulate under a plant will eventually degrade into one inch of humus, the most powerful and resourceful earthen material known to exist.

The steppe prairie that once comprised Santa Fe’s soil horizon was fairly stable for at least 12,000 years, from the last major ice age forward. So there may have been at least one foot of humic topsoil in place at the time of the arrival of the Spaniards. Native First Nations peoples used minimally impactful agriculture before that time, and did not disturb this humus matrix in any meaningful way.

But due to European models of conquest, civilization and agriculture, from the early 1600s to 2022, almost all of the humic topsoil has been lost. This loss, as much as the global temperature warming of climate change, is why the native and introduced plant life in New Mexico is in rapid decline and has experienced such high mortality since the 1990s.

How to Rescue, Recover and Revolutionize NM/PP Ecology?

In three words, the answer to this question is:

Water - Microbiology - Composts

The soil matrix all plants live in, even in riparian habitats, must have all three elements to establish and maintain a stable but dynamic ecosystem.

Almost any existing soil/dirt contains some microbes, in either active or dormant forms. **But populations of microbes need to be in the billions of individuals per cubic foot** in order to establish both homeostasis and a thriving micro-environment in that unit of soil.

Thanks to irrigation, humans can supply the water, at least for now. But without active microbiology in large numbers operating in the dirt, plant life is very limited in its abilities to thrive. **Microbes actually produce plant foods, move biology in and out of plant root cells, create plant immunities to pathogens, communicate with plant proteins and interpret plant nutritional needs.**

But where to get the microbes? Composts.

Composts not only supply many thousands of species of microbes, they also provide humic material to generate future humus (plant and microbe food), create an insulation and water-retaining blanket on the top of the ground, keep soils from eroding, and attract adjunct biodiversity to the trees, shrubs and any grasses that are present.

This is the key ingredient in Park Plazas rejuvenation of its forest micro-environment. With the addition of a thin layer of mulch on top of the compost, everything changes in the extreme.

Composts and mulches can be pricey, or *bon marche*, or nearly/completely free.

A determined and adequately funded/staffed program utilizing water, microbes and composts/mulches, will renew Park Plazas, increasing the economic, aesthetic and ecological value of the property and its Nature, and be a revolutionizing example to all of Santa Fe about what Revolution in Nature looks and feel like.

Emergency Ecology Solutions is at your disposal to assist in this Century's greatest challenge.