



Mann Made Resources

Arborist Consulting and Tree Conservation Products

July 7, 2014

Mr. Jeff Gault, Operations Division Manager
City of San Ramon
2222 Camino Ramon
San Ramon, CA 94583

**SUBJECT: ARBORISTS REPORT FOR CONDITION OF REDWOOD TREES IN
RICHARD FAHEY VILLAGE GREEN AND ATHAN DOWNS PARKS**

Dear Mr. Gault,

Thank you for the opportunity to provide arborist consulting services. This report provides the findings from the inspection completed on Wednesday, July 2, 2014, and review of related City supplied information.

The assignment for this report includes:

- i. Site visit and inspection of the subject trees and other trees in three parks
- ii. Summary of findings
- iii. Provide options for tree management.

Mr. Gault contacted our office on Thursday, June 26, 2014 with a request to look at Redwood trees that are not performing well in two parks irrigated with recycled water. The trees are not doing well, and there have been some maintenance practice concerns with the park maintenance firm. The inspection is intended to provide an independent assessment of the situation and offer options for improving maintenance practices. Mr. Gault sent copies of soil sample reports, tissue sample report, and explained the history of recycled water use, and landscape maintenance practices in San Ramon parks.

Observations:

I visited three parks, Richard Fahey Village Green, Athan Downs, and San Ramon Central Park on Wednesday, July 2, 2014 starting at around 8:30 am. The first park, Village Green

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is the location of the Redwood trees felt by staff to be in the worst condition. I met with Jeff Gault, Operations Division Manager, Glenn Sautter, Parks and Landscape Manager, and Tom Slate, Parks Maintenance Supervisor. I visited the other two parks with Mr. Gault.

The Redwood trees and Camphor trees in Village Green park did not appear healthy. The Redwood trees had significant dieback, many brown needles, some dead branches, and some trees were beginning to sprout new foliage from the branches and trunks. The foliage on the Redwoods had several different appearances. Some needles were green at the base and tan-brown on the top half. Some of the needles had a tan-brown appearance on the entire needle. Some of the needles had a gray-purple hue. Some of the needles were dry brown. In the park near some of the Redwood trees there was turf that was recently replaced. It was explained that the maintenance contractor had killed some of the turf with herbicide. The park has been receiving irrigation with recycled water since 2006. Staff is currently using potable water on some of the trees on the northeast side of the baseball field to compare any differences with the trees only receiving recycled water.

I used a soil probe to take cores of the soil in an area of recycled water and current potable water, to check the soil moisture. The moisture in both situations was present to a depth of approximately 8 inches, the depth the probe was easily inserted into the soil. Staff turned on the irrigation system. The irrigation pattern appeared sufficient to deliver water to all the trees. The Redwood trees are located around the perimeter of the park, along the northerly border. Some of the trees are growing in a raised planter between a retaining wall and the border fence. Other trees are growing in a turf area and along the edge of a turf area.

The maintenance contractor was using a herbicide to kill turf and keep a clear area around the base of the trees. There were locations where sprouts on the trunks of trees appeared twisted and orange-brown color consistent with herbicide damage.

The second park visited was Athan Downs. This park has been irrigated with recycled water since 2007. The Redwood trees are growing around the perimeter on the north, west and southwest corner of the park. There were private Redwood trees growing just behind the north park fence irrigated with potable water, and some Redwood trees

growing along a pathway in a more natural setting beyond the north park fence with mulch over the soil that are irrigated with potable water. The Redwood trees in the park had similar needle symptoms as Village Green, although not as severe. The private trees and pathway trees exhibited typical Redwood leaf color and density. There also was the apparent trunk sprout herbicide damage at the base of some of the trees in the park. I took some soil cores to a depth of approximately six inches as far as the probe easily entered the soil, which showed adequate soil moisture is being delivered to the trees.

The third park visited was San Ramon Central Park. Central Park is irrigated with potable water. There were Redwood trees in mulched planting areas near the parking lot, and perimeter trees on the westerly edge of the ball fields. Most of the Redwood trees appeared normal in color and leaf density. There was one Redwood tree on the westerly border of the ball fields that appeared in poor condition with thin yellowing foliage, and dead branches. This portion of the turf area around this tree had a flooded soil area with standing water during our visit.

Other testing or examinations:

The City has performed soil tests and tissue tests in Village Green and Athan Downs parks. The data from those tests was sufficient to be used in the assessment and maintenance options formulation for this report. No other testing or examination were requested or determined necessary at this time. Future testing of the soil twice a year, probably mid to late April based on the precipitation for the current year, and either during or after the irrigation cycles for the dry season. This will monitor the salt levels in the soil that may be the health challenge for the Redwood and Camphor trees.

Discussion and Findings:

The Redwood trees in Richard Fahey Village Green park showed the worst symptoms. The trees had the most severe dieback, defoliation, and loss of needles. The Redwood trees in Athan Downs park showed some of the emerging symptoms of brown needles and dieback. The Redwood trees in Central Park showed the most normal conditions of the Redwood trees inspected.

The causes of the appearance of the trees in Village Green park is not simple and likely a combination of factors. The park has been irrigated with recycled water for the past 7 years. We are experiencing drought conditions throughout California, and this is the third year in a row with low precipitation levels. The timing of the precipitation has also shifted during the drought conditions with precipitation occurring later in the season, greater in April than in January or February. When the timing of precipitation shifts, the trees do not receive the winter water and drier soils may stress the trees. When using recycled water, the winter rains work to leach and move the higher salt content from the recycled water through the soil profile. The lack of rain has caused a higher level of salt to remain present in the soil.

Redwood trees are a very nice landscape tree in the proper situations. The large stately appearance and evergreen canopy serves as a great border and perimeter tree, and a nice shady grove tree. However, outside of their native range, Redwood trees require irrigation over their lifespan. The bay area has a water supply challenge as does the State of California. In efforts to shift landscape irrigation from the potable water supply, less turf irrigation may be provided to nearby trees, turf has been replaced with artificial turf greatly reducing irrigation, and recycled water has been used for irrigation. All of these efforts have changed the water amount and quality available to landscape trees. The stress caused to the Redwood trees in San Ramon is most likely from higher salt concentration in the recycled irrigation water and the drought reducing winter rain and leaching of the salt levels. The higher soil salt concentration is evident in the trees that are declining.

The City has performed soil and tissue tests and I was able to review copies of the test reports. The parks irrigated with recycled water had much higher sodium and boron concentrations than considered suitable for Redwood trees.

Central park irrigated with potable water had lower sodium and boron levels in the soil and the trees showed better foliage color and density. The Redwood issues observed in Central park were related to over-watering with one tree, and likely other issues that affect Redwood trees. There are three fungi that affect Redwoods: Botryosphaeria canker, Cercospora blight, and Seridium canker. These diseases affect the needles and branches a little differently, have a slightly different appearance on the leaves, and can affect

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different parts of the foliage in the tree from lower, to upper, to branch tips, to inner needles. There are no prescribed or recommended fungicides to effectively treat these three fungal diseases. The best approach is to maintain healthy trees and prune out diseased branches which can serve as a source of fungal spread.

The most significant evidence of high salt issues with the Redwood trees most likely causing the damage to the needles and foliage was present in the needle tissue sample. The tissue analysis¹ from Athans Downs park Redwood tree found:

“Tissue Boron was very high. Copper was just into the low range. Iron and manganese were very high. Zinc was high. This tissue was found to contain 3,680 ppm sodium. Normal sodium levels in Sequoia spp. are in the range of 50 to 150 ppm.

Boron and/or sodium toxicity is suspected from high soil boron and sodium levels. Visual foliar symptoms are consistent with boron and/or sodium toxicity.”

The soil analysis² from Village Green park east side by the drain which was checked for herbicide residue found:

Glyphosate 0.253 mg/kg, and AMPA a degradation product of glyphosate 0.459 mg/kg. “The sample was tested as received. The amount of glyphosate and its first order metabolite AMPA that was found indicates a residue level typical of a medium to high rate application of a product containing glyphosate herbicide within the last three to six months.”

2, 4-D ND mg/kg, and Oryzalin ND MG?KG, ND = none detected. “No 2, 4-D or Oryzalin was detected at the analytical detection limit of 0.01 milligrams per kilogram. These results indicate that these compounds were not present in significant herbicidal amounts.”

The soil samples from Village Green Park and Athans Downs taken prior to the use of recycled water in 2005 showed less than 100 ppm sodium in both parks. The 2014 soil samples showed Village Green sodium at 1,116 ppm, and Athans Downs at 1,092 ppm. The 2014 soil sample for Central Park showed sodium at 157 ppm. Soil sodium levels normal range is 50 – 150 ppm. The drought may also be reducing the salt leaching that takes place in potable water locations.

My findings are that there were herbicides used in the parks around the trees, and there was some herbicide damage to sprouts at the base of some of the trees and to the turf that has been replaced in some areas at the time of my inspection. There is no indication that the herbicide use is the primary or even a critical factor in the declining condition of the Redwood trees.

The primary conditions that are affecting the Redwood trees is the use of recycled irrigation water, and the affect on the drought in not flushing the soil of accumulated salt levels. The lack of rain in the winter may have required the use of the irrigation system to keep the park turf and landscape green since no natural water was provided. This has the opposite effect on salt levels because instead of leaching salts in the rainy season, more salts are added. The salt levels are so high that even the late April precipitation was not enough to leach the salts from the soil. There are also some foliar fungal diseases present on the Redwoods, contributing to the poor appearance. There is no recommended treatment for the fungal diseases.

Maintenance Options:

The Redwood trees have a good chance of sprouting back with the addition of lower salt irrigation. It will likely take several to many irrigation cycles with potable water to leach the salts from the soil and improve the salt levels in the tree tissue. Once closer to a normal salt level range is established, it may only take a couple interchanged cycles of potable water with the recycled water to keep the salt concentrations in the soil at an acceptable level for the trees.

The routine, frequency and alternating of recycled water with potable water will need to be monitored with soil tests, and will be contingent on the natural precipitation timing and amount, and irrigation water quality. The use of mulch can serve as a soil improvement over tree roots. Placing a cover over the bare soil with a ground tree parts mulch material that breaks down over time reduces the sun from baking the soil, improves the organic matter content of the soil, and can reduce the irrigation needs by protecting the soil from drying as quickly. As an alternative to spraying herbicides around the base of trees, the use of mulch accomplishes reducing herbicide use, reduces weed growth, reduces the

need for mowers to operate near trees, and protects the soil. Mulch should not be piled over the trunk flare. Sprouts at the base of trees should be pruned off, and may be treated with plant growth regulators to reduce re-growth.

From an urban forestry perspective, four factors that are often missed in project and landscape designs are species diversity, age diversity, plant spacing and irrigation delivery. Consideration of these four areas will support a more sustainable landscape.

Species diversity – most landscape designs include groups, lines, or large planting of the same species. If there is an insect, disease, recycled water issue, or other issue affecting one species, the entire park, street, or landscape will be affected and very noticeable. Future designs and tree replacement should consider a planned species diversity such as from 10% of a maximum species use for street trees and 20% maximum species for landscape trees. Intermixing trees of acceptable and desirable attributes provides more robust appearances with varied leaf color and texture, flowers, fruit, fall color, and deciduous or evergreen foliage.

Age diversity – When a new site is planted, all of the plants are the same age. It is not sustainable for the entire canopy to last forever. At some point in the life of the landscape, some trees may die, some may need to be replaced, and some should be replaced to develop a mixed age stand of trees. The mixed age inventory have a percent older, a percent middle age, and a percent young trees. The mixed age canopy can sustain a planned percent canopy cover. There should be a full-stocking plan to accomplish where at some point in time, all available planting sites will be full, with selecting the the right tree to grow in the right place for the right purpose. While 100% full stocking may never be achieved because trees will continue to die and need replacement, the full stocking plan guides the tree planting and species diversity levels over time.

Plant spacing – most new landscapes are overplanted. If the correct plant spacing was used, the landscape would look weak and bleak until the plants grow closer to their intended size over time. The new plant material is usually small, is expected to grow and fill in to desired heights and spreads, and typically grow into each other because they were not spaced correctly. Each landscape installation should have a maintenance plan to

guide the final desired spacing, irrigation modification as some plants are thinned, and support for maintenance staff to transplant or remove trees and plants over time to achieve the proper spacing. Also necessary in considering plant spacing is to provide enough soil space for the trees' eventual mature size. Some of the border Redwood trees in the parks inspected may be too close to the border fence, retaining wall of the planter, or walkways, and over time may cause an infrastructure conflict. Providing enough space for the tree achieve mature size without competing infrastructure damage reduces future maintenance expense and premature tree removal that often occurs during infrastructure repairs.

Irrigation delivery – Many landscape designs include tree and turf irrigation on the same valve, and using the same or similar heads. The soil depth needs of trees and turf differ, and irrigation delivery designed for turf may be insufficient for the trees. If the trees and turf are on separate valves, when we have to cut back water to the turf, we can still deliver the necessary water to the trees. If we have to run dual systems of potable and recycled water, having the trees and turf on separate valves allows the cycling of potable water with recycled water to the trees, and recycled water may continued to be used on the turf.

To guide the improvement in condition of the Redwood trees in Village Green and Athan Downs parks, leaching of the salts in the soil has to be completed using a lower salt level irrigation source. Once the salt levels are brought into an acceptable range, the use or alternate use of potable and recycled water will most likely be necessary to manage a soil salt level acceptable to the trees. Over the next few years, if natural precipitation occurs, it may be possible to irrigate in the dry months with only recycled water. Monitoring will be necessary to figure out the right combination to achieve the desirable soil salt levels for healthy Redwood trees.

The Redwood trees appear to be sprouting new foliage along the branches and trunks. Pruning will be needed to remove dead branches. Dead branches may not be every branch showing brown needles or no needles. The cambium may be alive while the needles have turned brown. The branches will need to be checked for live cambium and where to prune to remove only the dead branches.

The removal of the dead branches in most Redwood trees will reduce the risk of branch failure when dead branches fall, allow more reasonable monitoring of the trees to see how fast, if at all, more branches are dying, and improve tree appearance. If the trees are pruned to be fairly clean, it is simpler to monitor the amount of dead branches that occur over time. If the trees are left with dead branches, it is more difficult to discern how many "new" dead branches occur.

Some of the poor condition Redwoods may die and need removal, or may be removed as a spacing plan to achieve the proper spacing between trees allowing the trees to grow to their natural spread without growing into the adjacent tree or trees. Some of the poor condition Redwoods may be replaced to change the species, and the replacement trees could work towards improving diversity and using species more tolerant of the salt present in recycled water.

Mr. Gault said Central Park is being considered to be irrigated with recycled water. What has been learned from Village Green and Athan Downs parks should be used in the design of the recycled water irrigation delivery for Central Park. Design enhancements may include:

- Removing the turf under tree groves, covering the soil with mulch, and changing the way the water is delivered.
- Providing dual irrigation sources of potable and recycled water for trees sensitive to salt will allow for planned leaching of the soil salts as the need arises.
- Consider a treatment like Gypsum to reduce the sodium in certain locations.
- Continue to improve the specifications for park maintenance to reduce herbicide use around the base of trees with sprouts, and include more mulch for the reduction of weeds and turf around the bases of trees.

Staff is currently irrigating a sample of declining Redwoods in Village Green with potable water to flush and leach the salts from the soil. The observation and monitoring of this

activity will guide the future recycled and potable water use and monitoring, and help support the design of the irrigation with recycled water in Central Park.

Redwoods in their natural settings enjoy a soil pH range of 6.0 to 6.5. The soil samples from the two parks show a pH range at the sample sites of 6.8 to 7.4. A component of the soil management will need to consider the pH, and manage and monitor it over time.

Village Green and Central parks are serviced by the same maintenance contractor and Athan Downs is serviced by a different maintenance contractor, all working within the same maintenance specifications. One maintenance requirement is to keep the bases of the trees clear of turf and weeds. According to herbicide use records, the contractor has been using a herbicide spray containing one or two of the following products, Ranger Pro, manufactured by Monsanto, and Pendulum, manufactured by BASF Corporation. The active ingredient in Ranger Pro³ is Glyphosate, which has a mode of action that translocates through live foliage or cambium tissue of established plants and inhibits an enzyme found only in plants and microorganisms that is essential to formation of specific amino acids, and stops the growth of the root system. The active ingredient in Pendulum is Pendimethalin⁴, a pre-emergent meristematic inhibitor that interferes with the plant cellular division or mitosis and cell elongation in the growing points of shoots and roots of susceptible weeds. There are not any similar effects on the trees in Central Park compared to Village Green and Athan Downs that would demonstrate herbicide damage is involved in the declining tree conditions.

Conclusions

The Redwood trees in Village Green and Athan Downs parks are experiencing decline most likely due to the combination of recycled water irrigation and the drought conditions reducing the natural precipitation leaching of the salts in the soil. City staff is addressing the situation and using options like potable water to flush the salts and improve the tree health. There are several management options possible to improve the short term and long term condition of the affected Redwood trees. It may be beneficial to check the soil sooner than two or three months into the potable water sample area test. If it is reducing salt content in the soil, it may be prudent to consider the same application for other

declining trees sooner, and consider some other applications such as Gypsum to try and reduce sodium sooner in the trees' active growth cycle.

I certify that all the statements in this report are true, complete and correct to the best of my knowledge, and that all statements are made in good faith. Please contact me at 650-740-3461 or gordon@mannandtrees.com if you have any questions.

Sincerely,



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Photos



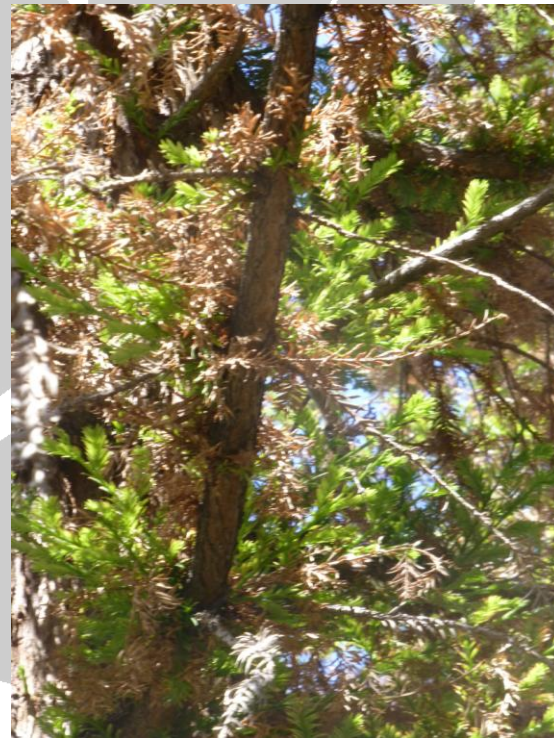
Browning trees in Village Green Park



Sprouting of needles along brown foliage branches



Sprouting of needles along trunk



Sprouting of needles on branches



Left branch - dead cambium; right branch – live cambium, found under removed bark



Declining Redwood in Central Park



Flooded soil around declining Redwood in Central Park

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9. This report is based on the observations and opinions of Gordon Mann, and does not provide guarantees regarding the future performance, health, vigor, structural stability, or safety of the plants described herein. The author assumes no responsibility for the safety of the people or the property in the vicinity of the trees described in this report.
10. This report is based on the condition of the tree at the time of the inspection. Any change to an established tree's environment can cause its decline, death and/or structural failure

Bibliography:

- 1) CLC Labs report ref 3078.022, June 5, 2014, Redwood plant tissue analysis
- 2) clc Labs report ref 829.063GLY and 829.063ORY24D
- 3) Ranger Pro Herbicide Label, <http://www.cdms.net/LDat/ld6FU017.pdf>
- 4) Pendulum Herbicide Label, <http://betterturf.basf.us/reference/library/past-product-labels/pendulum-wdg-herbicide--label.pdf>