TOWN OF FAIRFAX
STAFF REPORT
March 3, 2021

TO: Mayor and Town Council

FROM: Garrett Toy, Town Manager

SUBJECT: Receive presentation on Redwood Tree Maintenance Plan (Plan) from the Town Arborist, discuss/consider the Plan, and direct staff as appropriate.

RECOMMENDATION

Receive presentation on Redwood Tree Maintenance Plan (Plan) from the Town Arborist, discuss/consider the Plan, and direct staff as appropriate.

DISCUSSION

The Town Arborist, Urban Forestry Associates, has prepared the attached "Redwood Tree Health, Stability Maintenance Plan" (Plan) for the Town's redwood stand in Peri Park. At the meeting, the Town Arborist will make a presentation to the Council regarding the Plan. Staff will be working with the Town Arborist to implement the Plan. We will also be working with the Marin Municipal Water District (MMWD) to evaluate the cost structure for this additional watering. At the Council meeting, staff will have information regarding the Town's current water usage. Please note that if MMWD imposed water restrictions due to drought conditions, this may restrict the ability of the Town to irrigate the redwood trees at the recommended level and/or result in a very significant increase in water costs for the Town.

FISCAL IMPACT

tbd

ATTACHMENT

Redwood Tree Maintenance Plan

URBAN FORESTRY ASSOCIATES, INC.
8 Willow Street San Rafael, CA 94901
(415) 454-4212 info@urbanforestryassociates.com

DRAFT
REDWOOD TREE HEALTH, STABILITY MAINTENANCE PLAN
for:
The Town of Fairfax, California

PURPOSE

Ray Moritz of Urban Forestry Associates, Inc. was asked by Town of Fairfax to provide a Peri Park redwood maintenance plan. I inspected the site and individual trees on many occasions and walk the stand about three times a week to monitor tree health and stability.

SPECIES CHARACTERISTICS

Species Biology

Coast Redwood, *Sequoia sempervirens*, has few enemies that affect tree stability other than fire, Brown Cubicle Rot, *Poria sequoiae*, white ring rot, *P. albipellucida*, and logging / edge effects (trees newly exposed to winds due to clear cutting or extensive thinning). Redwood does not have tap roots but where it develops large, wide-spreading lateral roots, it is considered to have better than average windfirmness.

In the heart of its range redwood is an extremely fast growing species, particularly coppice (second growth) stems which have a well established root system from the start. Even first growth seedlings may grow 18 inches in the first year and saplings commonly grow 2 to 6.5 feet per year. Coast Redwood does its best on deep alluvial flats where soils are built up and soil nutrients replenished by sediment deposits from successive floods.

This species is well adapted to sedimentation fill. Repeated floods may deposit as much as 30 feet of silt, sand and gravel around old growth trees. The trees are not harmed by this. They quickly develop new and higher root systems in the new deposits (USDA FS Handbook 271, page 664).

Redwoods have no tap roots but lateral roots are large, very shallow and wide spreading. It can tolerate the loss of major portions (30 to 50%) of its root system through stream cutting, sedimentation (fill soil) or mechanical removal and suffer no significant threat to the over-all health of the tree. It sprouts a new root system quickly from adventitious buds. This species is well adapted to sedimentation fill. Repeated floods may deposit as much as 30 feet of silt, sand and gravel around old growth trees. The trees are not harmed by this. They quickly develop new and higher root systems in the new deposits (Handbook 271, page 664).

Multiple-stemmed and multiple topped trees are more subject to windthrow and wind breakage than single stem trees with single leaders.

Coast Redwood is extremely shade tolerant due to very efficient photosynthesis. It is extremely tolerant of fire. It can lose most or all of its branches and yet recover quickly (fire column), with branch regrowth of 18 to 24 inches per year or more. It will quickly reproduce a natural crown. Annual shoot growth of Redwoods is 18-36 inches in an unirrigated forested setting. It is very tolerant of thinning.

Redwood is subject to windthrow when there has been extensive selection harvesting or intense fire but

subordinate, co-dominant and edge or exposed trees are the most affected. It normally does not develop large Asail@ crowns. Its natural form is columnar and airy with live crown ratios of 30 to 40 percent.

Daughter trees around the stump or divot of a lost mother tree are more subject to windthrow due to unbalanced root systems.

Multiple-stemmed and multiple topped trees are more subject to windthrow and wind breakage than single stem/leader trees.

Coast redwood is extremely shade tolerant due to very efficient photosynthesis. It is extremely tolerant of fire. It can lose most or all of its branches and yet recover quickly (fire column), with branch regrowth of 18 to 24 inches per year or more. It will quickly reproduce a natural crown. Annual shoot growth of redwoods is 18-36 inches in an unirrigated forested setting. It is very tolerant of thinning. The native range of coast redwood extends from the fog belt in the Coast Ranges from northern San Luis Obispo County, CA. north to southwestern Oregon. Cultivated in parks and gardens, thriving best in cool and moist districts.

Maino and Howard - **direct quotes**

Because of its great height, the tree should never be considered for use in small gardens; in large gardens it can be used as a lawn specimen or can be planted in groups to simulate groves. Successful hedges are made of the trees by topping and trimming them, although it seems a form of desecration to destroy such tall, stately grace. Redwood tolerates cold and some heat and grows best in a moist atmosphere.

Growth - "Diameter growth of young trees can be rapid or very slow. In dense stands where competition is severe, annual radial increment is commonly as little as 1/30th of an inch. Occasionally there are 100 rings per inch. At the other extreme, radial growth is as much as 1 inch a year. Dominant young growth trees on good sites are 100 to 150 feet tall at 50 years" (USDA, FS, Hand. Book. 271, pg. 667).

STAND CHARACTERISTICS

SITE HYDROLOGY

The current stand occurs on the flood plain of the Fairfax Creek, which is a natural, but not optimal, location for coast redwood to occur inland of the fog zone. The water table is probably quite high but may fluctuate greatly. In one location in the Ross Valley where I have checked the water table it has dropped from 6 feet below grade to more than 20 feet. This may be due to the prolonged drought, but the increase in impermeable surfaces throughout the Ross Valley watershed have also reduced rain infiltration and recharge of the ground water.

SOIL CONDITIONS

The use of the stand as an urban park has also affected the hydrology of the site. Park users have scarified the soil breaking down surface soil structure and compacting the surface layer (the A horizon). Park use has also removed the natural “O layers” of unaltered organic materials like mulch (twigs and leaves) and decomposed organic materials (The O horizon is like compost) that protect and open the soil surface. The organic layers also insulate the soil from temperature extremes. The natural soil structure created by chemical (organic acids, etc.) and physical actions (like wet/dry cycles) permit good water and air infiltration. Root development, symbiotic fungi development and the roots’ ability to uptake soil water, minerals and nutrients are dependent on a healthy soil. The removal of the mulch-like organic layer and the O horizon (natural compost), compaction, and the mechanical scarification, which creates a crust during wet weather, have created an unhealthy soil environment, an unhealthy root environment and consequently an unhealthy stand.

PLANT BIOLOGY

The stand consists of coast redwood (*Sequoia* sempervirens), California bay laurel (*Umbellularia californica*), Orgon ash (*Fraxinus latifolia*), white alder (*Alnus rhombifolia*), valley oak (*Quercus lobata*) and big leaf maple (*Acer macrophyllum*). All of these species are common to riparian (stream side) zones. However, coast redwood dominates this stand.

Most of the redwood trees in the stand are “second growth”. The original “mother” trees were likely harvested in the late 1800s or the early 1900s. One of the responses of coast redwood to wildfire mortality of mother trees is to reproduce vegetatively from stump sprouts (“daughter stems”). The same response occurs after logging of first growth redwood trees. The daughter stems surrounding a mother stump often form a circle commonly called a “fairy ring”. These groups of stems from a given mother stump are actually one tree but many in this stand have been assessed as separate trees for the purpose of health and risk assessment.

Second growth redwoods do not achieve the heights and girths of first growth redwoods but they grow rapidly at first because they are tapped into the mother tree’s vast root system. However, they slow their rate of growth later due to crowding (too many trees or stems per unit aerial space and soil volume). As you can see from the tree survey map and photos there is a severe crowding. Note some dots represent more than one stem. The crowding is extreme in some areas of the park and the trees are stunted as a result. (See Figures 1, 2, 3 & 3b)

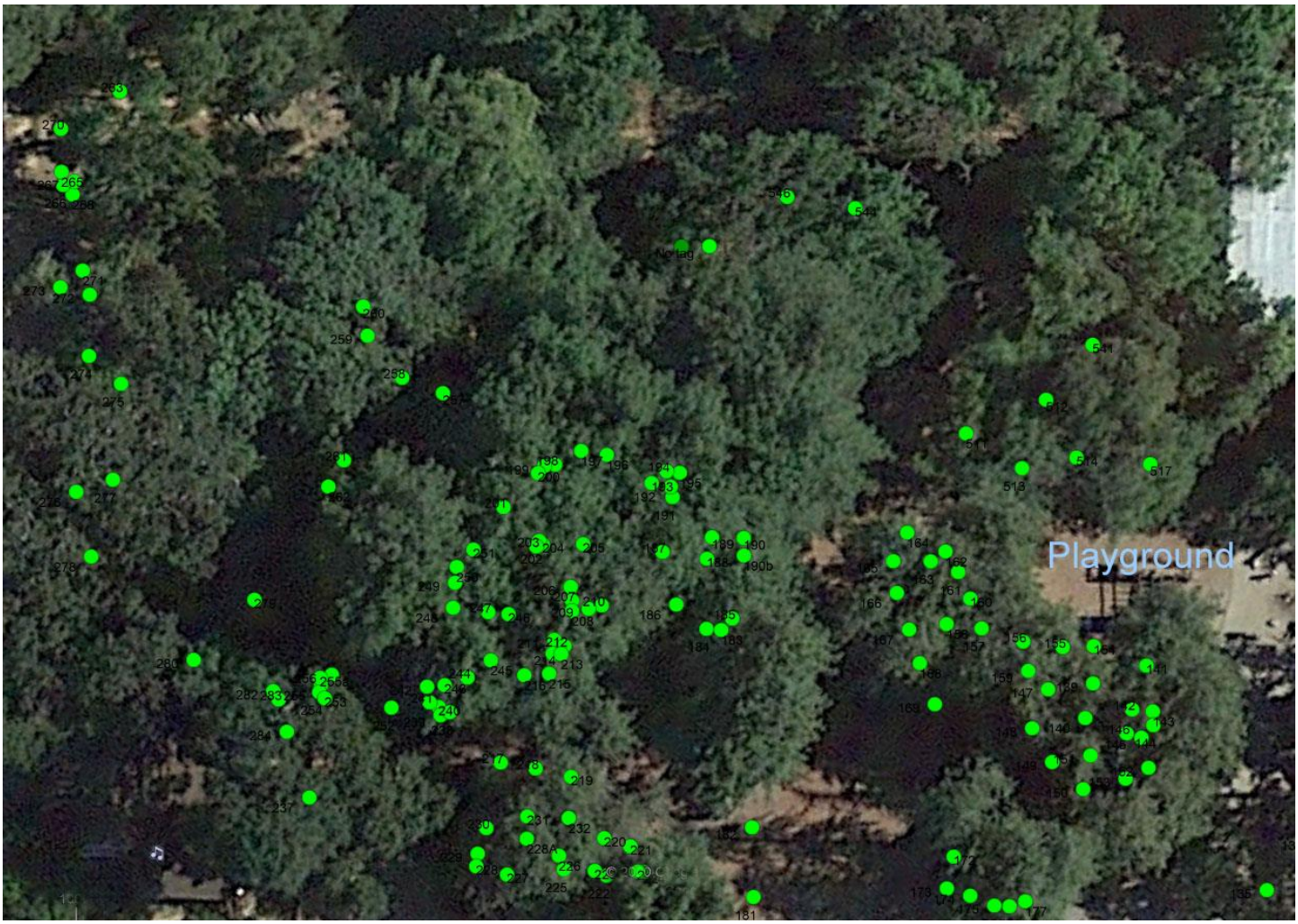


Figure 1 – Peri Park Redwood stand. Fairfax Creek runs along the more exposed areas at the top of the photo.

Figure 2 – As with any organism too many individuals per unit area leads to stress, poor vigor and poor health. Crowding also inhibits their response to abiotic (drought, freeze, etc.) and biotic (bacterial, fungal, & other pathogens, and insect pests).

Figure 3 – The trees in this second growth, crowded group are largely stunted due to insufficient growing space and soil resources for the number of trees per unit area. Redwoods may have as many as 100 sprouts per stump after logging. Gradually the sprouts are thinned through natural competition for light, growing space and soil resources (water, minerals, and nutrients) (See also Figure 3b).

Figure 3b – While there are areas of the park that are quite open, the areas where the trees are located are very crowded. There is insufficient room for canopy growth and too much demand on limited soil volumes.

Second growth redwoods and bays laurels begin life attached to the “mother stump” and the large, well-developed root system of the mature, first growth (from seed) mother tree. They eventually develop their own root systems. Often the second growth root system are shaped like pie slices radiating out from the mother stump center. Consequently, they are not as windfirm as the first growth threes. Also, the decaying mother stump is connected to the bases of the daughter stems and the decay organisms extend from the mother stump into the daughter stem roots and trunks (where the decay is called heart rot). This is visually evident in the redwoods and bay laurels in the stand and has resulted in tree mortality, tree failures and safety removals (See Figures 4, 5, 6 & 7).

Figure 4 – This group has lost a number of trees due to extensive heart rot (brown cubicle rot).

Brown Cubicle Rot (*Poria sequoiae*)

Fig. 4b

Figures 4b and 4 c – The second growth trees in this group developed brown cubicle rot through their connection to their mother stumps.

The decay extended the to the point where they rendered the stems unstable, and they had to be removed. They may have broken prior to removal. (See Figures 6 & 7)

Brown Cubicle Rot *(Poria sequoiae)*

Fig. 4c

TREE FAILURES

In recent years tree failures have accelerated for ash, second growth bays and second growth redwoods. The crowding of certain groups of trees, second growth characteristics and advancing decay are at fault. Whole tree failures and trees that failed in the past and have since developed third growth tops are the major concern. First growth redwoods are the most windfirm of all of its associate species but second, third and in some cases fourth growth trees, where it is a race between growth and decay, are far more subject to failure (See Figures 8, 9 & 10).

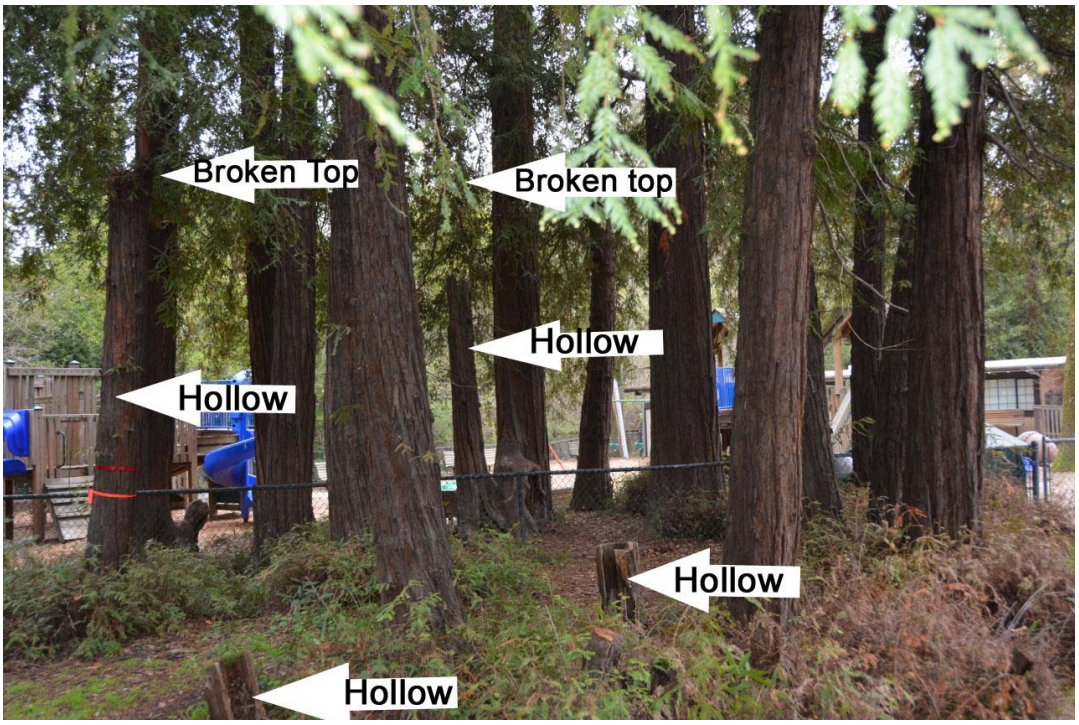


Figure 5 – Mand hollow (heart rotted) trees and stumps are scattered throughout the stand. A number of these trees have broken off and others have begun to lean and are a failure threat.

Figure 6 – Recently failed hollow trunk. Brown cubicle rot has decayed heartwood.

Figure 7 – This hollow tree has assumed. a serious lean and the sap wood has died.

Figure 8a – This second growth stem with a portion of the mother stump attached. It has little Space for compression roots toward the creek and no tension roots extending away from the Creek, which would be sticking straight up if, post failure, they existed.

Figure 8b – The close-up photo shows 2 other daughter stems (left), the decayed mother stump in the middle and the “root crown” of the failed stem with no tension roots, lower right.

Figures 9a & 9b – Note the multi-stem second growth bays in the background of figure 8b above. Figure 9a shows the decay that migrated from the mother stump into the daughter stems. Figure 9b (right) show how the daughter stems had to develop opposing leans to get adequate light and growing space. This is a recipe for past and future failures.

STAND DECLINE

The redwood stand has displayed accelerated decline in recent years due to the logging history, species characteristics, stand characteristics, the use history and the recent cutting of basal sprouts (Figures 10a-c).

The long history of stand use for recreational activities, meet-ups, picnicking, dancing, exercise and dog walking has scarified and compacted the soil. Fire prevention and flood control have interrupted nutrient and mineral cycling but have also protected the stand from the ravages of fire and flood. The stand does have a history of being mulched but in recent years there has not been adequate mulching. Redwood forests typically have a deep (4" to 6") organic layer cooling the soil, preventing evaporation, recycling nutrients and minerals, and improving soil structure and soil pH. Natural stand materials (tree debris) are not removed from the stand.

This inland site is far from optimal for coast redwood. Fog is infrequent, summer weather is warmer and drier and soils moisture is far less. The summer height of the water table is more than six feet below grade (See Figure 11). Climate change (hotter and drier) and the prolonged drought have also taken a toll. While there were prolonged droughts historically, the recent drought was unprecedented in that it was hotter than the mega-droughts of the past. The creek has no visible water over much of the summer drought.

Stand decline has been evident for years but the recent cutting of the sprouts and reproduction has decreased photosynthate production (sugars, tannins and other critical photosynthates) and increased wind movement through the stand reducing the stand's relative humidity, stressing the foliated canopies and drying the soil. It also killed a lot of the sprout growth creating a more highly available fuel around the bases of the trees that could be ignited by air-born embers and damage, or even kill, mature trees (See Figure 11).

Fortunately, all of these stand stresses can be mitigated, and the stand environment can be improved over what it has ever been. Good culture can improve the decay to growth ratio and improve its health and stability

Figure 10 – The stand elevation is six to eight feet above the stream channel. The drought season water table would be below the 114' AMSL and the prolonged mega-drought may have dropped the water table (WT) even deeper and beyond root access to the WT and capillary fringe.

Figure 11 – The unauthorized cutting of basal sprouts increased wind through the understory of the stand desiccating the sprouts and soil. This elevates the fire risk to the trees should embers enter the stand and ignite the dead and desiccated basal sprouts. This ill-considered cutting has also impacted the mature trees.

PERI PARK STAND MAINTENANCE

MULCHING TREE WORK CHIPS (WOOD, BARK, LEAF)

Mulching reduces water loss more than 50% versus shaded bare soil and by 75% versus exposed bare soils (2004, Harris, Clark and Matheny, Arboriculture , 4th Edition). This is an affordable, organic alternative to expensive bark products, some of which may be generated by tree work in the stand. “Clean” tree chip mulch suppresses weeds, conserves moisture, and moderates soil temperatures. Its decay products improve soil structure and control erosion. As it slowly breaks down, it provides the organic matter, nutrients and microbes that help plants thrive. Worms and insects thrive in soils that have a generous layer of mulch. Their tunneling activities allow oxygen to get to plant roots and their castings and frass provide beneficial nutrient inputs.

Compost enriches the soil and opens the soil for rain/irrigation infiltration and aeration. The organic acids in compost help build soil structure. It provides soil organisms (beneficial bacteria and fungi). It provides slow-release macronutrients that are often absent in Franciscan Formation soils. It helps retain soil water. Most importantly for the scarified and compacted soil of Peri Park, it holds the surface layer open after mechanical aeration. It also provides soil organisms for the breakdown of the mulch applied later in the soil restoration process. The use of tree chips which contain leaf matter will compost over time and provide these benefits.

FERTILIZATION

The Marin County Franciscan Mélange soils are far from being plant nutrient-rich, productive soils to start with, but are good at retaining nutrients once they have been applied through fertilization. Peri Park forest needs macronutrients and micronutrients immediately available to get a good spring flush of sprout growth and leaves, greater live crown ratios (percent foliated canopy versus total height) and better compartmentalization of decay. The fertilization should occur in late February after the compost application, and aeration have taken place and immediately before irrigation, followed by mulching and installation of permanent irrigation. The fertilizer should contain 50% readily available Nitrogen and 50% allow release nitrogen. Mineral application would also help stand recovery. Oak tree chips and leaf matter have a relatively high mineral content.

SOIL AERATION

The surface soil has what is called a massive structure which inhibits air and water infiltration. Absorbing roots are ephemeral and must regrow frequently. Poor aeration and low soil moisture constrain absorbing root and symbiotic fungi (mychorrhizae) development and thus, water and nutrient uptake. Mechanical core aeration would break up the soil crust, surface compaction and incorporate compost and fertilizer into the upper A horizon of the soil profile. The incorporated organic matter will help keep the surface open to air and water infiltration. Park use soil compaction destroys macropores which reduces gas exchange (release of toxic gases and oxygen infiltration). Poor soil aeration can produce the same symptoms as low soil moisture.

IRRGATION

Depending on the height of the water table and the capillary fringe above it, the drought stress symptoms may be due to gas exchange stress rather than low soil moisture. However, the prolonged drought has caused drought stress in trees throughout Northern coastal California and the Sierra Nevada killing millions of trees.

Irrigation will be required for at least the first (2021) drought season to make mulch decay products and fertilizer more available and improve soil permeability. A simple Stand mounted Rainbird-type irrigation may be employed. However, it would have to be moved around manually to provide deep watering to the entire stand irrigation should penetrate the soil to 18 inches below grade. This might require as much as 6 hours of irrigation in the first two cycles.

Any trenching to install water lines should be done pneumatically with AirSpade®- type equipment.

RESTORATIVE ACTIONS TO AMELIORATE THE POTENTIAL IMPACTS OF BASAL SPROUT CUTTINGS

The cutting of vegetative reproduction (large sprouts) and small root crown sprouts should be corrected. The first action would be to remove the dead material to protect the trees from fire char and/or scorch, particularly on the trees with thinner bark. I recommend volunteer training by the Town Arborist for pruning out the dead material. The unprofessional cuts on larger reproduction should also be corrected. The aeration, fertilization and irrigation will encourage new sprout growth, which could grow as fast as three feet in the first year. To encourage rapid growth, we could thin the sprouts for the first couple years to favor the dominant sprouts.

TREE CARE

Urban Forestry Associates' recent survey has recommended some tree removals. The 2020 Tree health and stability survey found that nine (9) trees were priority 1 (highest) for removal, three (3) trees were priority 2 for removal and two (2) trees were priority 3 for removal. A total of 14 trees out of 537 Peri Park trees were recommended for removal.

Other tree work will also occur as needed. No tree chips should ever leave the stand. Trees and branches that are removed contain nutrients from the air, water and soil. We should close the nutrient loop by requiring that all tree debris be broadcast chipped within the stand.

Of particular concern to all of the arborists that have assessed the stand (UFA, McNair and The Treeman tree service) are the Valley Oak trees in the playground. These old trees have been dropping limbs, perhaps retrenching (a common response to advanced age and both physiological and structural stress when the tree systems can't support the entire tree). Fortunately, most of the failures have occurred during storm conditions and/or at night when the playground is not in use. This area should be a priority area for regular health and risk assessment monitoring. Cultural care should address this area of Peri Park as the number 1 priority.

Even the best efforts at tree culture will not rescue the health of some trees that are senescent (in an inescapable spiral of decline). Other trees have severe structural defects that make them an immediate threat to park equipment, park users and other trees that would be a target of defect failures.

SUSTAINABILITY AND AMENITY FOREST LEGACY

Given the characteristics of second growth redwood and the conditions of this stand, I recommend that we begin planning and planting for a future first growth stand. My survey of the stand identified 15 locations for planting first growth trees that will provide long term sustainability, stand amenities, riparian habitat and carbon sequestration. An informed planting plan can ultimately lead to optimum spacing of the trees, improved stand health and long term sustainability.

I recommend that we plant first growth redwood replacement trees for every tree removed from the stand over the next decade. Then sustainable planting should be based on the remaining adequate growing space.

SCOPE OF WORK / LIMITATIONS

All determinations reflected in this report are objective and to the best of our ability. All observations regarding the sites and trees were made by UFA personnel, independently, based on our education and experience.

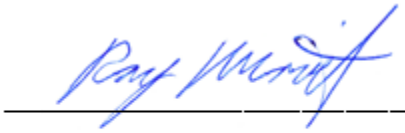
The health and hazard assessments in this report are limited by the visual nature of the assessment. Defects may be obscured by soil, brush, vines, aerial foliage, branches, multiple trunks or other trees. None of the subject trees were examined using invasive techniques such as increment coring or Resistograph® tests. The probability of tree failure is dependent on a number of factors, including: topography, geology, soil

characteristics, wind patterns, species characteristics (both visually evident and concealed), structural defects, and the characteristics of a specific storm, other weather or edaphic event. Structurally sound, healthy trees are wind thrown or weight failure during severe weather events. Consequently, a conclusion that a tree does not require corrective surgery or removal is not a guarantee of no risk, hazard, or sound health.

TREE WORK STANDARDS AND QUALIFICATION

All tree work, removal, pruning, planting, shall be performed using industry standards as established by the International Society of Arboriculture. Contractor must have a State of California Contractors License for Tree Service (C61-D49) or Landscaping (C-27) with general liability, worker's compensation, and commercial auto/equipment insurance.

Contractor standards of workmanship shall adhere to current Best Management Practices (where possible) of the International Society of Arboriculture (ISA) and the American National Standards Institute (ANSI) for tree pruning, fertilization and safety (ANSI A300 and Z133.1). However, structural stability is the primary goal.



Ray Moritz, Urban Forester SAF Cert #241