Superior NW Enterprises

November 6, 2024

Project: Pre-construction assessment for property re-development at 4661 Forest Avenue SE, Mercer Island, WA. Parcel number 4045000065.

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Objectives: Evaluate health of existing trees and establish criteria for the preservation of those to be retained. Provide risk assessments as necessary.

Description: The 4661 house was established on the property in 1930 and it was heavily renovated in 1955 (Figures 1). It sits at the west end of a long, rectangular, nearly ¾ of an acre lot near the center of the west side of Mercer Island. A detached garage was built in 1981 east and above the home on top of a concrete beam 'log cabin' retaining wall system (Figure 2). The property was owned by the same family for over thirty years before the current owners purchased it in 2021. The previous owners made few if any substantial changes to the property after the garage was built.

The home on the north side property was built in 1961 directly across from and less than 15' N of the subject home (Figure 3). It has been occupied by the same owner since 1996. The house on the south side 4703 property was built in 1954 at the east end of the lot. It has a large lower parking pad that is accessed via the 4661 driveway (Figure 4). This property has been owned by the same family for more than forty years.

The 4661 owners began working with RIPPLE Design on plans for a new home roughly located in the same place as the current one (Figure 5). The City of Mercer Island asked that a formal tree protection plan be created by a Certified Arborist as part of the submittals. RIPPLE Design reached out to Superior NW and site visits were completed in the spring of 2022.

The following itemized list begins at the northwest corner of the existing house and moves in a zigzag fashion east through the property. The tree diameter measurements were taken at the standard height of 54" above grade (DSH). Caliper measurements were taken at 6" above grade per industry standard. Heights were estimated. The trees were marked with orange 1" circular tags that switched to bright green at tree #19. The rough location of each tree is plotted on the 2019 aerial image shown in Figure 6.

1. Pin oak (*Quercus palustris*) 40" DSH standing 19' W of the NW corner of the existing house, 9' S of the north property line, and 35' E of the sea wall. The tree was cut back to the property line between 2007 and 2009 (Figures 7 and 8) and then was severely stubbed back between 2013 and 2015 (Figures 9 and 10). The top cuts were made between 25' and 28' above grade and the scaffolds were cut back to no more than 8' off the main stem. Currently there are epicormic sprouts extending off each of the cut points in groups of 5-10 and out 12-25' long. There is conflict and some die back present (Figure 11-13). Tree exhibits good health with decent new growth and color. It reaches up to near the 50' level and has a 20' radial spread. There is utility vault, maybe a pump house, in the northwest quadrant of the root spread 4' off the base of the tree (Figure 14). Concrete stairs lead up from the lower yard to the lower concrete patio. The tree has engulfed the top stair and a couple of the large stones lining it (Figure 15). There is uplift of the concrete path leading to the concrete patio and uplift in the patio itself (Figure 16). This tree is Exceptional by definition.

2. Japanese Snowbell (*Styrax japonica*) 9.5" caliper, 9' tall, with nearly a 9' radial spread, standing in a circular planter box at the south end of the rear patio (Figure 17). The brick wall is three feet out from the base of the tree. The tree separates at the 42" level and the scaffolds spread nearly horizontal. Exhibits below average condition with die back at the ends throughout the canopy.

3. Vine Maple (*Acer circinatum*) standing 22' S of the existing foundation and 3' W of the cinder block foundation for the boathouse. It is multistem with the mains at 3", 3.5", 4", 4", 4.5", and 6" DSH and five others less than 3" diameter. Reaches up to 25', out to the west 12-14', has nothing on the east side because of the building, and there has been some pruning to keep it out of the walkways in the lower yard area. Below average condition based on twig growth and structure. Exceptional by definition.

4. Shore Pine (*Pinus contorta*) 24" DSH, 50' tall standing 26.5' S of the house foundation and 8' W of the southwest corner of the little boathouse building. Ivy has filled the canopy to within 8' of the top and out the branches (Figure 18). It was recently cut at the base of the tree. Pine is in fair health but many of the branches are overextended and the canopy is windswept. There is a little existing fence filled with ivy that runs east to west 3' S of the tree. Just outside this fence and 16' E of the base of the tree there is some kind of drain system (Figure 19). This tree is Exceptional by definition.

5. Dual stem Western Red Cedar (*Thuja plicata*) 21" and 25" DSH and both were topped near the 18' level at least once. Currently they each have multiple leaders coming off these points going up to the 60' level (Figure 20). On the smaller stem most of the subordinates extend out to the west and southwest before curling vertical 4-6' out from the main stem. On the larger stem the majority of the spars turn vertical within 24" of the column. Almost all the limbs that originate below the topping point are turning up past their midpoints. The tree stands 11' E of the SE corner of the existing house in what is a de facto planter box (Figure 21). The west (house side) of the structure reaches at least 3' down and the retaining wall support system for the lower parking forms the east side. The base of the tree is against the east wall, 3.5' E of the west wall, and 2.5' SE of where the west wall angles to the NE. The 21" stem had poor resonance and is likely hollow.

6. Douglas fir (*Pseudotsuga menziesii*) 35" DSH standing at the base of the stairs leading down from the parking/driveway to the house (Figure 22). It's in another constrained, basically glorified planting bed, east of the northeast corner of the existing house. The retaining wall for the garage is 5' E of its base, the stairs leading down to the NE corner of the house are 4' W, of its base, the existing house foundation is 8' W, and the cross walk leading from the garage stairs to the house runs against the south side which has grown over it. The tree was topped or broke out near the 65' mark (Figure 23). The trunk below the topping point is vertical. Two large leaders rise above into the 100' range. One is nearly vertical but its attachment is offset to the column. Low average new growth. A subordinate spar (10" caliper) originates 4' below the cut line and grows up through the two dominates reaching close to 80' tall. Another 8" caliper subordinate comes off in the SE quadrant right at the cut point and reaches 75' tall. There is a torsion fracture low on the south face. Exhibits below average new growth. Tree is Exceptional by definition.

7. Douglas fir 26" DSH growing against the base of the #6 (Figure 24). The stairs are 3' W of its base, the house foundation is 7' W, the retaining wall for the garage is 6.5' E, and the cross walk is 28" S of its base. The foundation for the 4651 house is 14.5' to its north. The tree has two very large cankers in the 6' level (Figures 25 and 26). It leans slightly northwest from its base and never quite comes back to vertical. There is a damage point at the 24' level showing bleeding and indications of surface decay. Top of the tree bends over to the northwest. It might have been damaged by the larger #6 tree and/or have been topped near the 55' mark. The majority of its canopy extends west on large overextended limbs. It shows stunting in the upper canopy and is in below average condition.

8. Western red cedar 29" DSH standing in the north fence 8' N of the #7 tree, 8' W of the retaining wall foundation for the garage, 6' S of the 4651 foundation, and 12" E of the concrete for the stairs leading down around the north side of the subject house. There is a small wood retaining wall above the concrete and the tree is bowing it out (Figure 27). A subordinate that has been topped comes off the base of the main stem. The subordinate has an exposed decay column and atrophy running down its west face (Figure 28). The main tree was damaged or topped near the 40' level. There is a large leader growing up and out to the northwest that originates at the damage point and a number of subordinate spars reaching out all around the same level. The majority of the canopy extends north over the neighbor's roof. Tree is in below average condition with a light canopy cover and poor color.

9. Dual stem Big Leaf maple (*Acer macrophyllum*) conjoined from the base to the 4' level, 11" and 12" DSH, most likely topped for the power drop wires near the 22' mark. It stands centered 10' E of the existing garage and the large concrete retaining wall anchoring its east side. The tree's canopy extends mainly to the west side as much as 8' over the garage. The retaining wall on the east side of the lower driveway comes down and meets a small cross wall that ties into the garage wall. It creates a notch 13' to the west southwest of the maple's base. It shows minimal new growth, stunted foliage, and overextended branches. Weak condition overall.

10. Douglas fir 20" DSH, 65' tall standing 9' E of the end of the retaining wall running down the east side of the lower driveway. Tree is in below average condition and its entire canopy goes to the west side. It leans slightly northwest from the base does not correct. Tree was damaged or topped near the 40' mark. It has a new leader that kinks markedly to the northwest turning vertical as it rises (Figure 29).

11. Douglas fir 20" DSH, topped near the 40' level, and now has one large leader bending over to the Northwest that extends nearly 25' over the driveway (Figure 30). It only has a couple of other live limbs. Base of the tree is 9' E of the east edge of the lower driveway and 17' N of the inside edge of the last curve of the driveway. There are fungal bodies at the cut point. Tree is in extremely weak structural condition.

12. Douglas fir 39" DSH, topped or damaged near the 65' mark, now rises into the 90' level. There is an atypical growth pattern around the 65' area with a number of heavy lateral branches present and a larger subordinate coming off at this point. Tree has a subordinate spar that originates at the 20' level that has been pruned down to 8' tall and has a multitude of branches sprouting from it (Figure 31). Tree shows average new growth and color. It stands 40" E of the inside edge of the existing entry dive (Figure 32). The driveway curves completely around the tree scribing close to a 270 degree arc. There is a large amount of pitch leakage on the southwest base of the tree. Tree is Exceptional by definition.

13. There is a stand of three Big Leaf maple stump sprouts in the inner curve of the entry drive 10' above and east of the #12 tree (Figure 33). They have all been cut back multiple times likely both to their bases or using topping cuts around the 12' level. Their bases have decay pockets and their limbs have surface sunscald (Figures 34-37). Really poor condition.

14. Douglas fir 29" DSH, topped off near the 28' level, and only has four live branches coming off around the cut point (Figure 38). The limbs are over extended to the south and reach completely over the entry drive. Exhibits below-average color and new growth. It stands 32" NW of the inside edge of the entry drive.

15. Bigleaf maple 13.5" DSH, 60' tall with a quite narrow frame and very little scaffolding present. It has an 8' radial average spread with one 16' long branch reaching to the northwest. It stands 7.5' N of the #14, 7' W of the entry drive. Below average condition.

16. Douglas fir 34.5" DSH, topped or damaged near the 65' mark, has at least two main leaders that extend above this level into the 95' range. Majority of the canopy is above the separation point. Seven limbs grow below it. Tree exhibits fair color and below-average new growth. It stands 13' W of the entrance drive and 8' NNW of the #15. Some large deadwood present in the canopy. Exceptional by definition.

17. Big Leaf maple 12.5" DSH, standing 10' NE of the #16 and 10.5' W of the entry drive. Goes to about 50', bends to the northwest, increasingly as it rises, and its entire canopy is on two large scaffolds. One extends 20' NW and the other separates out into four limbs and reaches mostly north. Weak condition.

18. Big Leaf maple 16" DSH, 50' tall, 12' radial spread in fair condition. Stands 6.5' W of the entry drive, 19' NNE of the #17, and 12' SSW of the utility pole holding the transformer and the drop line leading off of it to the house.

19. Black Cottonwood (*Populus trichocarpa*) 28.5" DSH, 90' tall with a large lateral extending west close to 45', a smaller spar reaching 25' south, and the majority of the canopy carried on the main offset center spar. The tree slightly west from the base, increasingly so above the crook at the 40' level where the spars separate. Below this level there is little canopy, a 16" caliper branch extends to the southeast, another one grows out to the east. Exhibits abundant new growth, including epicormic, and decent color. Large cankers are present at the base and along the lower column. They larger ones show atrophy and decay present. The one at the southwest sector of the base is 42" across and 28" tall (Figure 39). There's one at the 7' mark that wraps the tree for half a circumference and is 20" tall (Figure 40). There's another one near the 11' level on the northeast face that wraps 1/3 of the circumference and is 12" tall (Figure 41). There's more than a dozen smaller ones scattered along the stem of the tree. Tree stands 8' N of the utility pole, 7.5' NW of the entry drive. The entry drive has been replaced recently in this area (Figure 42). There is evidence of large surface roots 27' away bumping up against an older section of the driveway (Figure 43).

20. Cottonwood 33" DSH, 90' tall, more vertical than the #19 and 12' N of it. Scaffolds extend out as much as 40' mainly to the northwest. Two large ones cross over the neighbor's driveway to the north. One large one reaches west far enough to hit the subject garage. Some epicormic sprouting on this tree, decent new growth, fair color. Has an area of atrophy or damage at the base at the southeast face (Figure 44). The tree has reportedly dropped several large limbs across the driveway.

21. Douglas fir 35" DSH accounting for very heavy lower bark. Tree reaches 80' tall where it appears to have broken or maybe been topped. There's a large spar growing to the northeast from this point that extends over the north side driveway. Tree exhibits good new growth and color and a heavy male cone load. It stands, according to the survey just north of the property line between the two driveways. It is 24' ENE of the #19 and 7' N of the curb line for the subject driveway and about 5' above it. The south edge of the neighboring driveway is 16' N of this tree. Exceptional by definition.

22. Cedar 6.5" DSH, 20' tall standing 26' E and slightly south of the #21. It is 2.5' N of the edge of the entry drive and 3' above it. Fair condition. Not shown on the survey.

23. Douglas fir 29" DSH, 85' tall standing above and just at the edge of the 40" tall retaining wall on the east side of the entry drive directly across from the #14 fir. Fair condition.

24. Big Leaf maple 11", 11", and 12.5" DSH, conjoined at the base and fully separate above 40" height, rising to 45' tall with the majority of the canopy reaching as much as 20' to the south. It stands 36' E of the retaining wall along the east side of the entry drive and 12' N of the rear deck on the 4703 house. The base of the tree is coming up through a concrete retaining wall framework (Figure 24). Fair health with some structural conflicts. Tree is not shown on the survey.

25. Douglas fir 21" DSH, 50' tall standing 28' N of the #24 Maple and 25' E of the entry drive and roughly 8' above it on the slope.

26. Stump sprout maple standing 21' E and slightly south of the #24 maple, 11' N of the foundation for the 4701 house. The stems separate shortly above the base and are 2.5", 6", 6.5", and 8" DSH. They reach into the 35' tall range and lean south over the neighbor's home stretching out as much as 14' south. Fair health but below average structure. The #28 Madrone's canopy crosses through this one's. Not on the survey.

27. Douglas fir 54" DSH taking the difference of the slope and accounting for an extremely heavy bark formation. The tree crooks slightly southwest as it rises and begins to go vertical above the 35' level. It was topped or broke over near the 70' mark and there are a handful of subordinates growing out around this area and an atypical limb formation. There is some overextension to the south. Average new growth and color with a heavy cone load. The tree stands at the top edge of the slope 16' on center north of the 4701 foundation, 17' on center east a little bit north of the #26 maple. Exceptional by definition.

28. Pacific Madrone (*Arbutus menziesii*) 15" DSH whose base is 14' N of the #27. It grows SSW at a 40 degree angle from the base, kinks over to nearly horizontal near the 18' level, goes out another 8' nearly due southwest and bifurcates. One scaffold continues to go horizontal to the west-southwest; the other goes south and begins to turn upright. Another spar goes vertical from the first bend and up to do nearly the 45' level. Tree is in good condition with nearly a full canopy, very little canker sign, and only slight dieback. It crosses through the #26 maple and is rubbing it in a couple spots (Figure 47). Tree is Exceptional by definition.

29. Maple 25.5" DSH, bifurcates at the 16' mark, the north side goes vertical into the 60' range, the south side curves out to the south turns up close to 8' off the column and reaches into the 50' level. Its canopy spreads as much as 24' radially. There is sunscald on the surface of the scaffolds, some crossing elements, and large caliper dieback in the main stems. Below average condition. Tree stands 19' ENE of the #27 fir, 18' NW of the edge of the driveway for the 4701 house.

30. Western Red cedar 28" DSH, 65' tall standing 12' NE of the #29 maple, 10' SW of the driveway as it turns south toward the 4701 property. Below average condition. The upper canopy is yellowing with limited new growth and sparse coverage. The lower third has better new growth and color. Tree has roots stretching up against the pavement as shown in Figure 48. There is a newly poured driveway section in this area (Figure 49). Tree leans slightly northeast from the base, never quite comes back to vertical.

31. Oregon Ash (*Fraxinus latifolia*) 15.5" DSH, 60' tall standing 7' E of the #30 cedar and 12" in from the edge of the driveway (see Figure 49). Tree leans southeast from its base, increasingly so as it rises, and the majority of its canopy extends to the south side on a large scaffold above the primary bifurcation point. Some of the branches have been cut back from the power lines running to the subject house. Exhibits average health for the species with normal epicormic sprouting lower on the column.

32. Douglas fir 25" DSH, topped near the 18' level for main power line clearance. It has regrown and been re-topped a number of times. The canopy extends to the west as much as 28' on a set of three large scaffolds and a handful of smaller branches (Figure 50). The scaffolds upturn and reach as high as 35' tall. It stands in the SE corner of the parcel 4.5' inside (east of) the curve of the shared entry drive.

33. Alder 22" DSH, standing 12' N and slightly east of the #32, 7' S of the utility pole carrying the main lines, and 8.5' E of the inside curve of the shared driveway. Tree had been completely full of ivy which was recently severed. It has been topped off near the 16' level and has a handful of branches with little viable growth present.

34. Western red cedar 13.5" DSH, 25' tall standing close to the NE corner of the parcel, 11' NW of the edge of the concrete near the top of the entry drive.

There are various other small trees scattered around the property most of which are in the upper area of the lot. None were deemed large enough to be considered as significant.

Methods: Tree assessment is both an art and a science. To properly perform, an arborist must have an extensive background in biology, tree mechanics, and tree structure that is equal parts academic and field knowledge. It takes years of study to recognize and correctly diagnose the subtle signs trees exhibit before their failure, whether it be partial or total. The process begins with a visual inspection (visual tree assessment, VTA) which is followed up as necessary with soundings, core testing, and/or other detection means. Each tree is examined and evaluated according to several factors including species type, size, vigor, injuries present, root and grade disturbance, deadwood, location and extent of decay, stem taper, exposure, and targets that are at risk.

The International Society of Arboriculture (ISA) spent a number of years developing a Best Management Practices bulletin to aid in their tree risk assessment program. Their methodology supersedes any and all other systems which may be currently in use. While focusing on a qualitative analysis the program is still based on the three primary aspects of tree risk; failure potential, size of part failing (potential of damage from impact), and target rating.

The aspects are scaled as follows. Failure potential (FP) can be imminent, probable, possible, or improbable. Target rating (T) is based on frequency of occupancy and is listed as very low, low, medium, or high. Selections are made in each of the first two categories and a likelihood of target impact found. It can be rated as unlikely, somewhat likely, likely, or very likely as shown in Figure 51. Obviously a level of null risk does not exist if a tree is present. For practical purposes however, arborists assume that if there is no target, the tree poses little or no risk.

The consequences of the failure, usually a function of size of the failed part, are listed as negligible, minor, significant, or severe. Combining the likelihood of a tree failure event with the consequences of that event allows a trained arborist to assign a level of risk to a given tree's situation. There are four risk categories within the model; Low, Moderate, High, or Extreme. The highest level, extreme, can only be assigned when the likelihood of failure and impact is high (very likely) and the consequences are severe (Figure 52).

Impact Analysis: There are three types of issues at this site; previous impact, primary construction impact, and secondary construction impact. The previous impact occurred where the driveway was repaired or work was done under it necessitating new concrete be poured. The primary impact zone includes the trees standing within a 10' envelope of the boundaries of the proposed new construction. The secondary impact zone includes those regions where the proposed construction work will cross into the Critical Root Zone (CRZ) of the site trees. This region is defined as a radial distance equal to one foot per inch of tree diameter. For example the #10 fir, with a 20 inch DSH, theoretically would want to have a 20 foot radial root spread.

In this case trees #1-15, #17-19, #21-23, and #30-32 stand in the primary impact zone. The existing concrete hardscaping is to be removed from around the #1 oak. The demolition and excavation for the new home and retaining walls for the autocourt will occur in close proximity, or over the top of, the #2-12 trees. The driveway demolition will potentially impact the #11-13 trees. The widening of the driveway will occur within 10' of the #13-#15, #17-19, #21-23 and #30-32 trees.

Typically all the primary zone trees are removed at project onset. In this case trees #15, #17, #18, and #21-23, #30, and #32 may be able to be retained and will be discussed below. Trees #1-14 and #31 will be removed during the demolition phase of the project. Tree #19 will be discussed further below but should be removed at construction onset as well.

Trees #19, #20, #30, and #31 are in areas where previous work on the existing driveway would have caused root disturbance. Trees #16, #20, #29, #33, and #34 stand in the secondary impact area. Their situations will be discussed below.

Trenching type incursion, that is excavation that will occur along only one sector of a tree's CRZ, can reach significantly into the root growth area without having a detrimental long term effect. What does have to be absolutely protected is a tree's Structural Root Plate (SRP). This radial area is again related to the diameter inches of the tree in question but not quite in a direct proportion as in the CRZ. Figure 53 below illustrates the relationship.

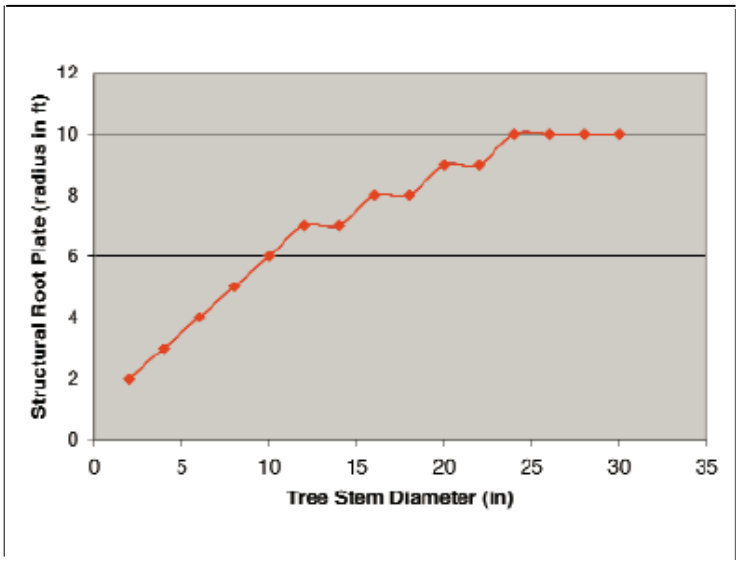

Figure 53. Size of the Structural Root Plate in relation to tree stem diameter. Note that the SRP levels off at 10' for any tree over 24" in diameter. (Coder, 1996)

The #15 maple should have a 7' SRP and the existing driveway is 7.5' to its east side. The proposed plans call for the entry drive to be widened from its current 10' width in this area to 12' across but it will be expanded more on the east side than the west. In order to create a 12' slab, at least 18" of space has to be created for forms on either side however. The excavation could end up within 6' of the base of the tree slicing through any structural roots between the tree and the existing driveway. Airspading along the cut line will expose any structural roots present.

The #16 fir is more than 10' from any potential impact and its SRP will not be affected. The #17 maple has a 7' SRP and is at least 9' from any potential impact.

The #18 maple is expected to have a 7.5' SRP but only stands 6.5' from the existing driveway. If there is no further impact to the tree, that is the forms for the replacement driveway are set at the edge of where the existing one lies, then the tree can be retained. **If this is not possible, or practical, the tree should be removed.**

The #19 would be expected to have a 10' SRP. It does have large roots pressing up to and most likely under the existing entry drive which is only 7.5' away. The previous work on the driveway had to have cut through a large sector of the cottonwood's structural roots based on the proximity and extent. This tree should have been removed at the time due to impact concerns. The current driveway replacement impact will occur within its theoretical SRP.

The #21 fir should have a 10' SRP but is limited to 7' of horizontal space on the subject property side of the line. This is a sensitive area and great care will have to be taken as to not disturb the roots of this tree as it is Exceptional and belongs to the neighbor. Any driveway work will have happen within the boundaries of the existing one. ***This is not negotiable.*** Any disturbance could destabilize the tree resulting in catastrophic failure.

The #22 cedar is also constrained to the subject side and will require the same care. It only has a 4' SRP according to the chart though and the new driveway construction should come no closer than 6' to its base.

The east edge of the new driveway comes to within 3' of the base of the #23 fir. On the site plan it is difficult to tell if the concrete retaining wall on the east side of the existing driveway is going to be removed or if the new driveway will just come right up against it. The tree should experience little to no impact as long as the wall remains. If the wall has to be removed then the tree will have to be removed also.

The previous driveway work likely severed the ends of any structural roots coming from the #30 cedar. Even though it is unlikely that the tree has pushed new structural roots past (under) the existing driveway the required excavation just to set the forms for the new driveway will sever at least another 1.5' off an entire 30% circumference swath on its east side. If the #32 fir is retained then the cut will be closer to 3' deep into the cedar's SRP and it will have to be removed.

It appears on the site plan that the new driveway will set about 12" closer to the #32 fir. Which means that the cut for the edge forms could be 2.5' closer to the tree resulting in 30-40% of its existing SRP being severed on its west side. It will necessitate the removal of the fir. If there is a desire on the part of the home owners to retain the #32 tree then this part of the driveway will have to shift west to maintain the fir's existing root system undisturbed. It is a 'better' tree than the #30 cedar all things considered.

Beyond using their roots for stability trees have to have enough square area to gather resources with the feeder roots. This region is defined in the same manner as the CRZ and is often called the Critical Rooting Area (CRA). In general trees can sustain losses of up to 30% of this space without having long term detrimental results. The chart shown in Figure 54 below is used to determine what percentage of a tree's CRA may be affected by trenching type incursion.

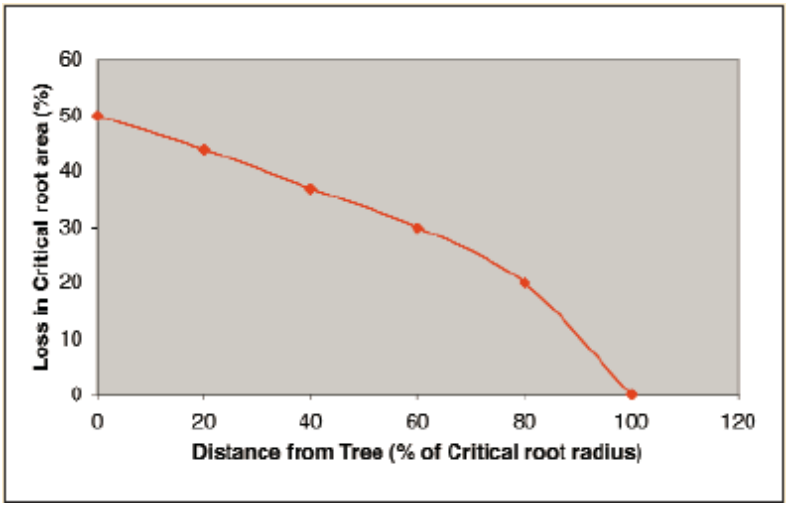

Figure 54. Chart giving the loss in critical root area as a function of the radial distance to the CRZ disturbance. (Coder 1996)

Based on its diameter the #15 maple would be expected to have a CRA of 570 square feet. The existing driveway prevents the maple from accessing roughly 30% of that space on its east side and it is likely that the tree has adapted by extending its roots further in the other directions. Conservatively the tree could have a realistic CRA closer to 460 square feet and the cut for the new driveway may excise a slice 18" wide and 10' long for a potential loss of 15' square feet or around 4% of its rooting space. This is a negligible degree of loss for the tree.

The #16 fir has access to roughly 2400 of its theoretical 3700 square feet of desired rooting space as it is constrained by the existing driveway to the east and the existing autocourt to the west. It could lose as much as 90 square feet of its CRA from the driveway widening. The expansion of the autocourt will carve out roughly another 120 square feet. In a worst case scenario the tree will lose less than 10% of its existing functional CRA and should suffer no long term ill effects.

The #17 tree will also lose less than 10% of its CRA to construction impact.

The #18 tree will either not lose any rooting space or will be removed due to impact to its SRP.

The #21 fir would ideally like to have 4534 square feet of rooting space. It is existing in an area closer to 2000 square feet. This makes every square foot of space worth twice as much as normal to the tree. This tree can ill afford to lose any space it is using which is why any changes to the entry drive has to stay within its existing north border.

The #22 cedar is protected within the CRA of the much larger #21 fir to its west.

The #23 fir will either not lose any rooting space because of how the retaining wall(s) on the east side if the entry drive prevents encroachment or it will be removed because of SRP impact.

The #29 maple sits inside the curve of the driveways as they cross on the east end of the subject property. The existing edge is 19' at the closest in the SE sector and 20' at the closest in the NE sector of the tree's rooting space. The proposed changes to the driveway layout will result in minimal losses to the maple's CRA. However, if the #32 fir is to be retained then the entire layout will have to be shifted such that the FORMS for the east side of the driveway entrance stay at the edge of the existing driveway. This will result in the west edge cutting roughly 3' into the curve around the maple for a loss of between 180 and 210 square feet of its rooting area. As the CRA loss will be around 7% it should have no long term negative effect on the tree.

If the driveway is pushed west to allow the retention of the #32 fir (as it should be) then the #30 cedar will be removed due to SRP impact and its CRA losses are moot.

If the driveway is held to its current location then the #32 fir will be removed due to SRP impact and its CRA losses are moot. If it is shifted then the fir should experience little to no root loss and will be fine long term.

Risk Assessments: There are two types of failures to consider when looking at this case, partial and catastrophic. Partial failures include branch, scaffold and fractional (less than half) stem breaks. Catastrophic failures look at basal and majority of stem breaks. For the most part the analysis will look at the current situations of the site trees. When applicable the tree will be considered post construction impact.

The targets within range of a tree differ according to the failure types. A branch falling out of a tree generally does not reach much farther out then the diameter of the canopy itself. Heavy winds may carry a branch sidewise for some distance but the range is directly correlated to the height of the break in the tree. Scaffold failures reach out to no more than 20% past their length. Hence the end of a 20' leader has the potential to hit something 24' away. A failure occurring mid stem can reach targets up to 10% beyond its length with factors for wind velocity and fall height modifying this range to some extent. Trees which uproot or have basal failures cannot strike targets outside their own height in anything less than hurricane force winds.

Several of these trees have the same type of issues and will be analyzed collectively.

Decay and weak attachment at the old topping points are significant issues for trees #5-8, #10-12, and #16. All these trees, save the #16, stand in close proximity to the subject home. The #8 is tight to the 4651 house and the #16 is in easy reach of the existing garage. They are exposed to the strong storm winds that come in over Lake Washington. Each of the trees has **probable likelihoods of upper spar failure.** They would have **high likelihoods** of hitting one of the homes and/or the garage. This puts the trees in the **likely to fail and impact** row. The spars are large enough cause **severe** damage. These trees are categorized as **high risk for partial failure.**

Many of the large branches and scaffolds on the #5, #7, #12-14, #27, and #31-33 trees are over extended and/or weakly attached. The trees stand in locations such that when these sections crack off they will be able to reach the homes and vehicles in the parking areas beneath. These trees have **probable likelihoods of branch or scaffold failure.** This puts the branches/scaffolds in the **likely to fail and impact** row of the second matrix. The consequences could be **significant** but are just as likely to be **minor**. These trees are thus rated as **moderate to high risks** for branch or scaffold failure.

As discussed in the section above, trees, especially the large apical dominant evergreens common to the northwest, have well defined and studied structural root systems. The situations of the #5-8 trees with their highly constrained placements illustrates both the resilience and adaptability of these species and the concept of "right tree, right place". Each of these trees should have the full 10' Structural Root Plate to be fully stabilized. None of them do. But they have grown up in place and somehow managed to adjust to their plight.

A case could be made for these trees having **probable likelihoods of catastrophic failure** when their compromised root plates are combined with the storm winds commonly experienced in the region. For sake of argument they will be assigned as '**possible'.** The real issue is what happens when the hardscaping around them is tampered with. The trees have to have locked in against the retaining walls in some fashion to create an artificial stability. If this tightly intertwined system is disturbed it will automatically escalate the likelihood of failure for the trees. No matter the starting point the trees end as being **high risks** with **extreme risk** not out of the realm of possibility.

The #19 and #20 cottonwoods have their very own unique risk portfolios. The two have **probable likelihoods of scaffold or large limb failures** in the 6-14" caliper range**.** Cottonwood trees are notorious for being weak in structure. They are one of a handful of species that are known to be susceptible to the sudden limb drop phenomenon, a condition where a tree will shed a large limb on a calm day for no apparent reason. Cottonwoods appear consistently in the tree failure data base with failed crotches, broken limbs, sheared spars, and uprooting. The more rapid the growth of these trees the more prone they become to these types of failure. These two have grown quite rapidly, are head and shoulders above the surrounding trees, *and are fully and increasingly exposed to each and every storm wind traveling up the lake*. The added weight from one-sided development in these trees adds to the propensity for their failure.

The stems and large branches which break out of these trees will have **medium likelihoods** of hitting pedestrians walking down the driveways, **medium likelihoods** of hitting a vehicle using either of the entry drives, and **high likelihoods** of hitting the 4651 home or the subject garage. This puts the cottonwoods in the **somewhat likely to fail and impact** row of the second matrix for moving targets and the **likely to fail and impact** for stationary ones.
The **consequences will be significant** in either case. This makes the #19 and #20 trees **moderate risks** for pedestrian and vehicular traffic and **high risks** for the buildings under and around them.

The #19 tree has a **probable likelihood of catastrophic failure** due to the degree of structural root damage and the advanced cankers along the lower trunk with their associated decay. It is tall enough to reach the 4649 home along with all the other targets listed above. It classifies as a **high risk**.

Recommendations: There is a combination of circumstances at this site. The demolition and construction processes will necessitate the removal of trees #1-12 which close around the house, garage, and autocourt. Risk issues associated with many of these trees add to the reasoning for their removal.

Widening the driveway creates SRP impacts which, combined with the weak structure of several of the trees, places trees #13-15 firmly in the removal column.

The #18 maple may or may not have be removed depending on exactly how the driveway lays out in real time. The #23 tree is in the same situation.

Either the #30 cedar or the #32 fir will have to be removed depending on the final layout of the driveway. Neither is in great condition but neither is in such poor condition that it can be condemned outright.

The #31 ash was heavily impacted by the previous driveway work. It also has a weak structure with not much to prune back to. It should be removed at project onset. Likewise, because of its compromised structures due to years of adverse power line clearance pruning and poor health, the #33 alder should also be put out of its misery at the beginning of the project.

The #19 and #20 cottonwoods should be removed in the short term whether the project proceeds or not. These trees have already been dropping large limbs and will continue to do so. The #19 has been compromised both mechanically and biologically to the point of becoming a significant risk to persons and property.

It would make sense to remove the #24 and #26 stump sprout maples in order to prevent issues which are just starting to arise due to their placement.

On the other hand there are a number of trees which should be protected diligently namely the #16 fir, #21 fir, and especially the #27 fir and the #28 madrone. These are great trees and worth the extra effort to preserve and protect.

When the excavating of the driveway is to occur, either for removing the lower section or the widening work, the areas should be opened with an air spade to expose the layout of the roots. If there is a high concentration of structural roots in the proposed work space then that tree will have to be carefully considered for removal. Any feeder roots in the vicinity of the forms work will have to be cut cleanly.

It is vitally important to ensure that there is no root disturbance around the #21 tree. If this means shifting the layout of the driveway then that is what will HAVE to happen.

Setting up tree protection fencing before project onset, even before the demolition, will ensure that no accidents will result in having to remove one of the large trees slated for retention. Making sure that the contractors understand what the fences mean and that they cannot move them without arborist oversite is critically important for the health and longevity, if not outright safety, of the onsite trees. No materials can be stored, even temporarily, within the protection zones.

Fencing has to be erected to designate no impact zones at the distance proscribed by the City of Mercer Island for non-incursion which is one linear foot per linear inch of tree diameter. Orange vinyl barrier fencing can be used, although chain link is preferred.

Typically all the trees which are to be retained are protected by laying down a layer of arbormulch to cushion their roots and provide long term nutritional supplementation. The rough rule of thumb is 6-8" of mulch spread out to 3' past the existing driplines as possible.

The removal of the driveway around the trees should only occur with an arborist present to monitor the work. Once it carefully lifted out (ideally by hand but this is not practical) the protection fence should be set at the edge of the inside curve of the new driveway space. As the work begins to expose roots during either the demolition or construction phases, systematic hand root pruning, rather than tearing and shearing by machine, should be done. As the arborist should be on hand when working within the CRZs of the trees so they can assist with showing how to do this to the onsite crews.

The #21 fir and #22 cedar can be protected by running the fence from the corner near the #19 cottonwood east for 40' past the base of the fir. This will hopefully prevent trucks from accidentally running off the side of the drive and over their roots.

The #27 tree should be fenced in around the upper driveway. The fence can be erected to follow the inside curve of the entry drive and wrap south and along the edge of the 4703 property.

In general it would be a good idea to remove the volunteer holly and maples growing around the site. They will become problem trees rather than assets.

It is highly advised to do aerial inspections of the topping/damaged areas on the large retained fir trees. Some level of remedial pruning will have to address the adverse reaction growth in these trees. Weight reduction on the laterals and perhaps even reduction of the lateral spars will have to be completed. The degree of pruning will depend on the strength of attachment and the formation of the wound sites.

Replacement trees will be required for those that are removed. The number can be negotiated with Mercer Island to some extent. Based on the current removal count, size of the trees removed, and a number of them being listed as exceptional the total comes to 51 trees. Half of these will have to be NW native species.

Waiver of Liability Because the science of tree assessment is constantly broadening its understanding, it cannot be said to be an exact science. Many variables beyond the control, or immediate knowledge, of the arborist involved may adversely affect a tree and cause its premature failure. Internal cracks and faults, undetectable root rot, unexposed construction damage, interior decay, and even nutrient deficiencies can be debilitating factors. Changes in circumstance and condition can also lead to a tree's rapid deterioration and resulting instability. All trees have a risk of failure. As they increase in stature and mass their risk of breakdown also increases, eventual failure is inevitable.

While every effort has been taken to provide the most thorough and accurate snapshot of the trees' health, it is just that, a snapshot, a frozen moment in time. These findings do not guarantee future safety nor are they predictions of imminent events. It is the responsibility of the property owner to adequately care for the tree(s) in question by utilizing the proper professionals and to schedule future assessments in a timely fashion.

This report and all attachments, enclosures, and references, are confidential and are for the use of Jeffrey Almeter, RIPPLE Design Studio, the home owners, and their representatives only. They may not be reproduced, used in any way, or disseminated in any form without the prior consent of the client concerned.

Note: When this report was initially completed the author held the certification of a Qualified Tree Risk Assessor. He has NOT renewed the certification and while the analysis is completely correct the stake holders may need to have the trees re-documented by an arborist with said qualifications.

Anthony Moran, BS
Certified Arborist
ISA #PN-5847A

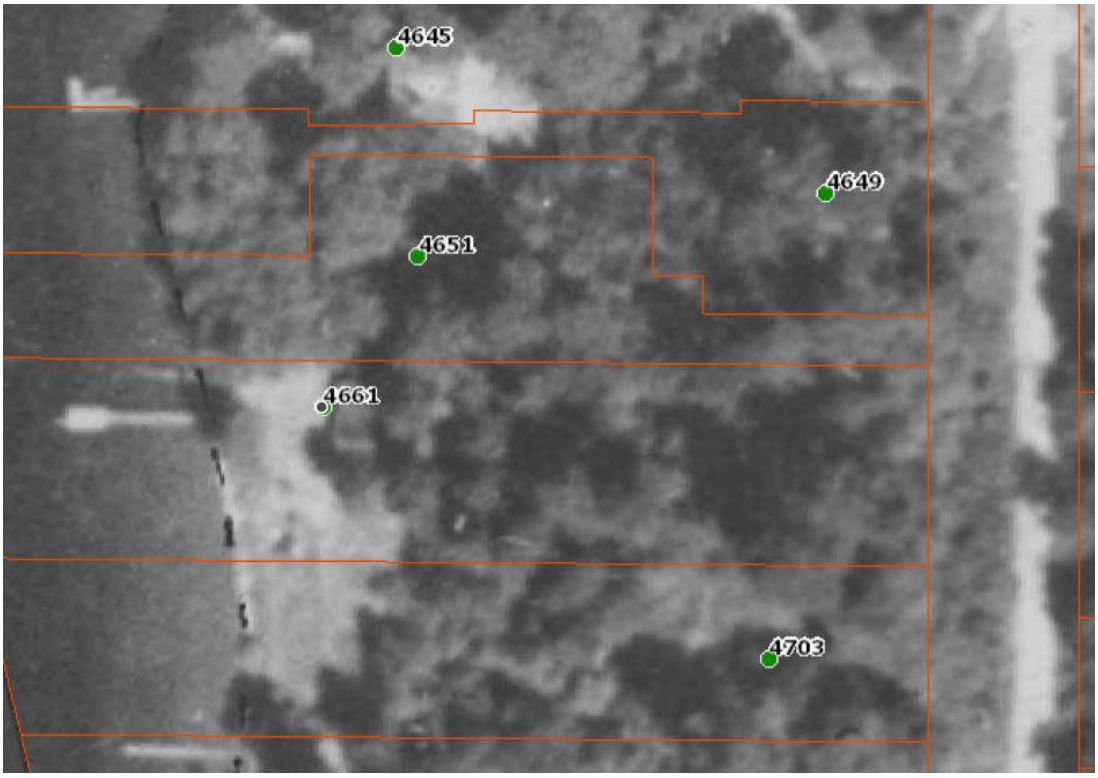

Figure 1. Aerial imagery from 1936 showing an overview of the subject and surrounding properties. Note the heavy tree canopy coverage at this time. This is right before the existing home on the 4703 property was built.

Figure 2. Looking north down the line of the retaining wall system that supports the lower parking are and the garage.

Figure 3. Aerial from 2015 showing the 4661 layout in relation to the 4651 property.

Figure 4. Aerial from 2015 showing the parking pad for the 4703 house.

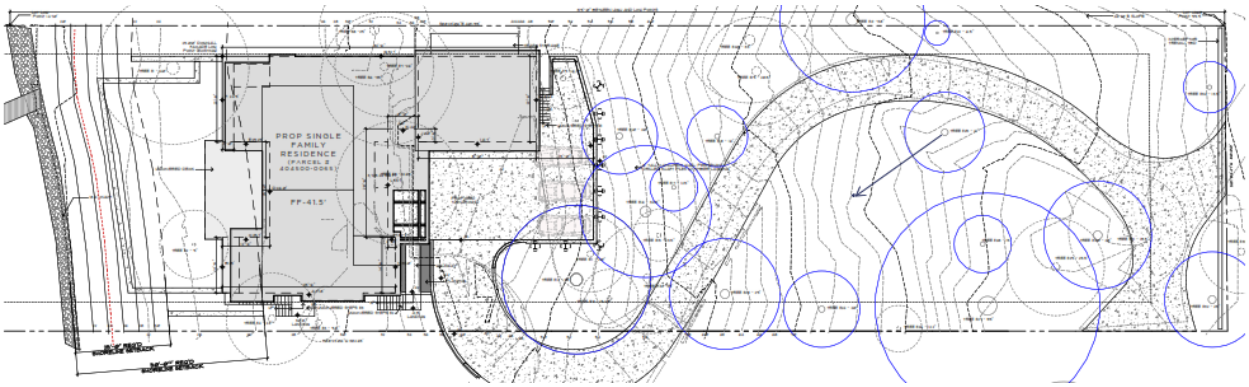

Figure 5. Excerpt from the site plan showing the proposed new layout.

Figure 6a. West end of the tree plot overlaid on a 2019 aerial image.

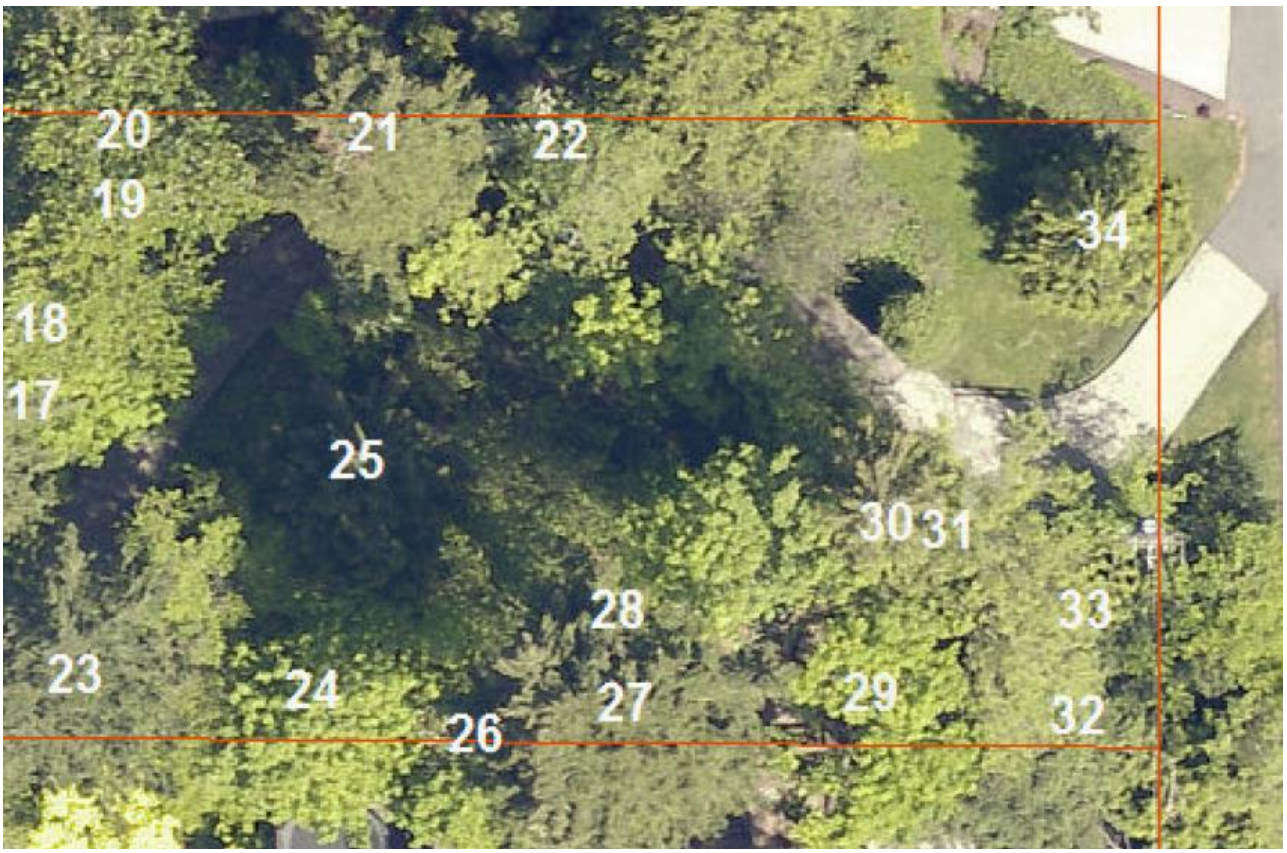

Figure 6b. East end of the tree plot overlaid on a 2019 aerial image.

Figure 7. Aerial from 2007 showing the #1 oak

Figure 8. Aerial from 2009 showing the #1 oak having been pruned back to the line

Figure 9. Close up aerial from 2013 showing the #1 oak.

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Figure 10. Close up from 2015 showing the #1 oak stubbed back to near nothing.

Figure 11. Looking north at the structure of the #1 oak.

Figure 12. Looking up into the canopy of the #1 oak showing dieback on stub.

Figure 13. Showing decay and atrophy at another of the stub points on the #1 oak.

Figure 14. Looking east at the base of the #1oak showing the pump vault.

Figure 15. Close up of stairs at the base of the #1 oak.

Figure 16. Looking west at the base of the #1 oak showing uplift of patio.

Figure 17. Looking east at the #2 Styrax in the planter

Figure 18. Looking east at the #3 pine showing the ivy growing through the tree and its structure.

Figure 19. Looking east at the drainage system

Figure 20. Looking at the lower canopy structure of the #5 cedar.

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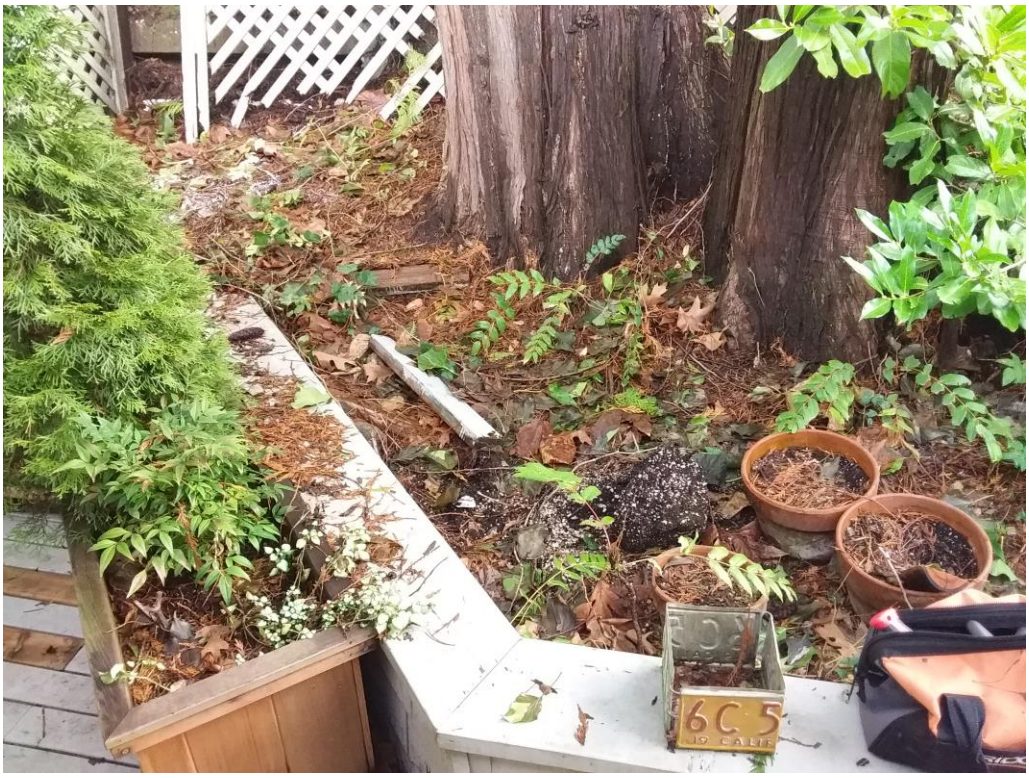

Figure 21. The base of the #5 cedar in the planter box.

Figure 22. Looking down and east at the base of the #6 fir.

Figure 23. Looking up and NE at the tops of the #6 and #7 fir trees.

Figure 24. Looking down and north at the bases of the #6 and #7 trees.

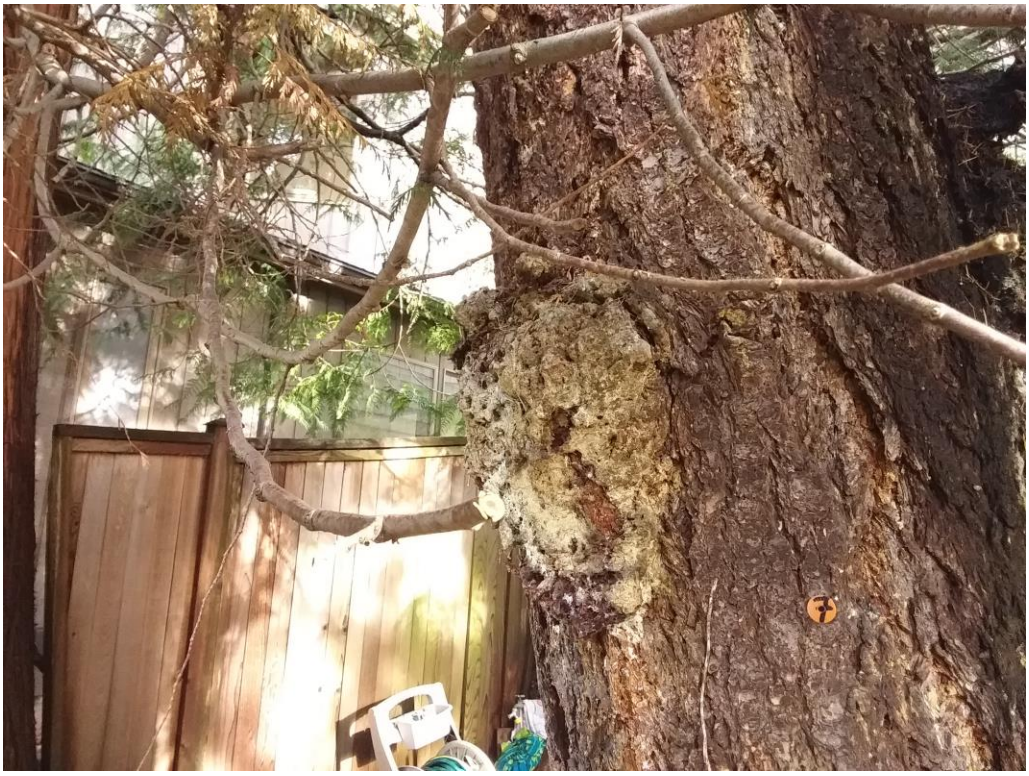

Figure 25. Canker at base of #7 fir.

Figure 26. The other large canker at the base of the #7 tree.

Figure 27. Looking down and north at the base of the #8 cedar. Note the wood retaining wall bowing out on the left (west) of the tree. The atrophy on the lower column of the subordinate spar is clearly visible.

Figure 28. Looking east at the lower formation of the #8 cedar.

Figure 29. Looking up and west at the structural fault in the #10 tree.

Figure 30. Showing the spar coming off the top of the #11 tree.

Figure 31. Showing subordinate spar coming off low on the column of the #12 tree.

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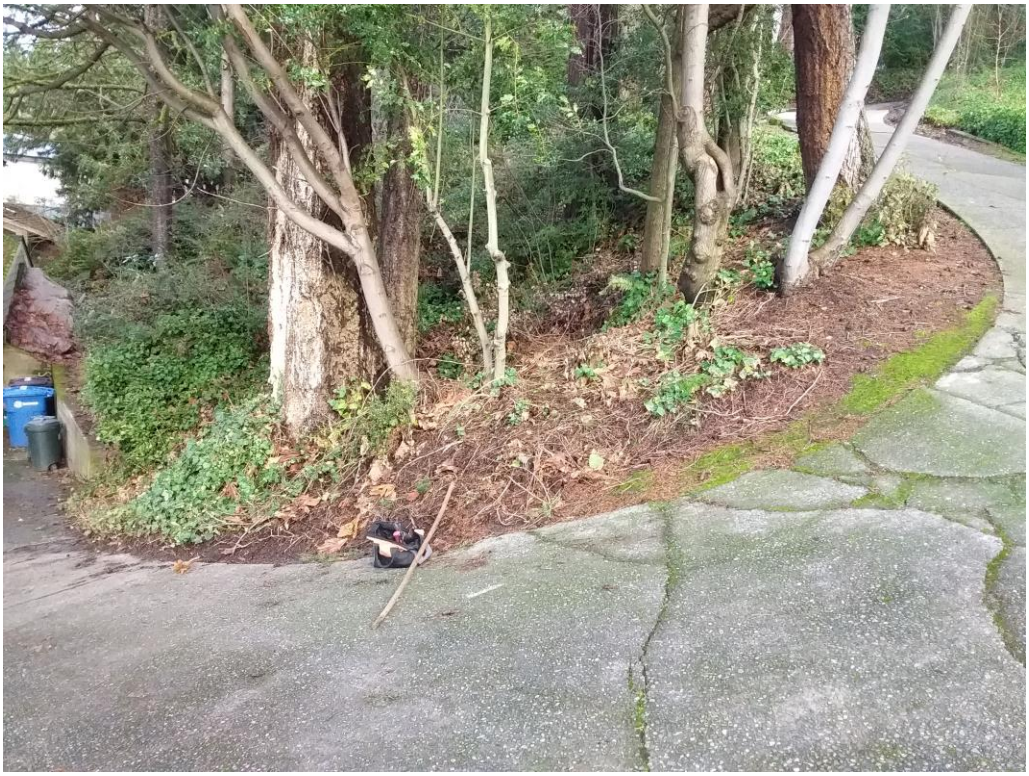

Figure 32. Looking NNE at the base of the #12 fir. The #13 maples are scattered around the east side of it.

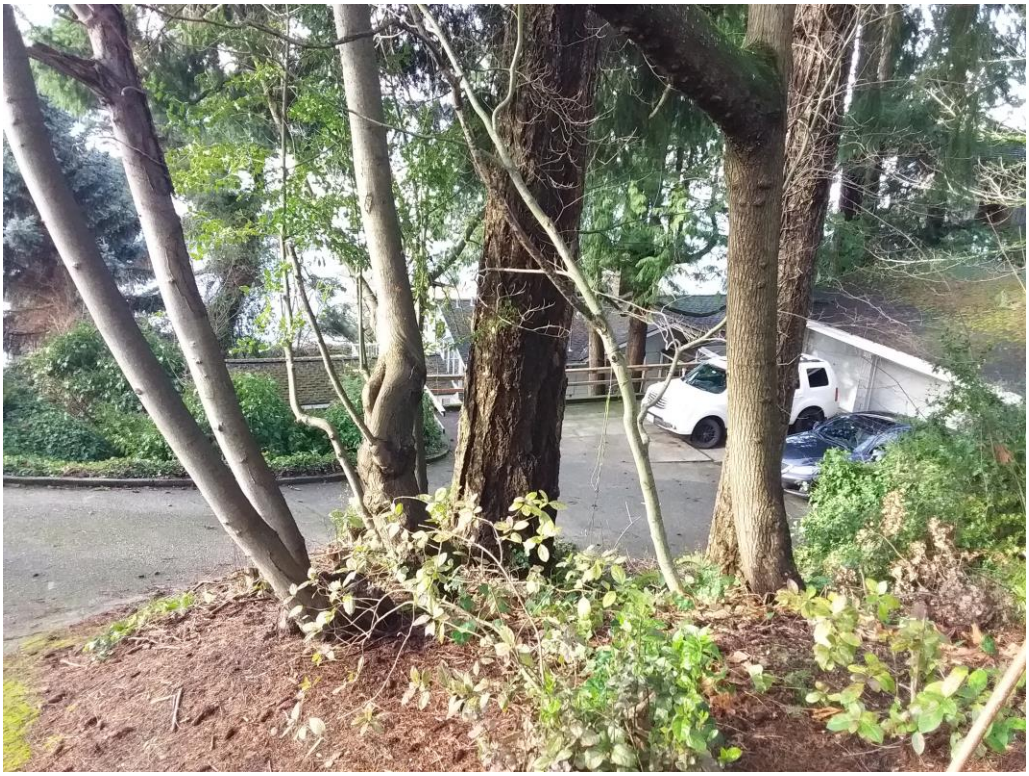

Figure 33. Looking west at the stems of the stump sprout #13 maple.

Figure 34. Looking down at the decayed base of one of the #13 maples.

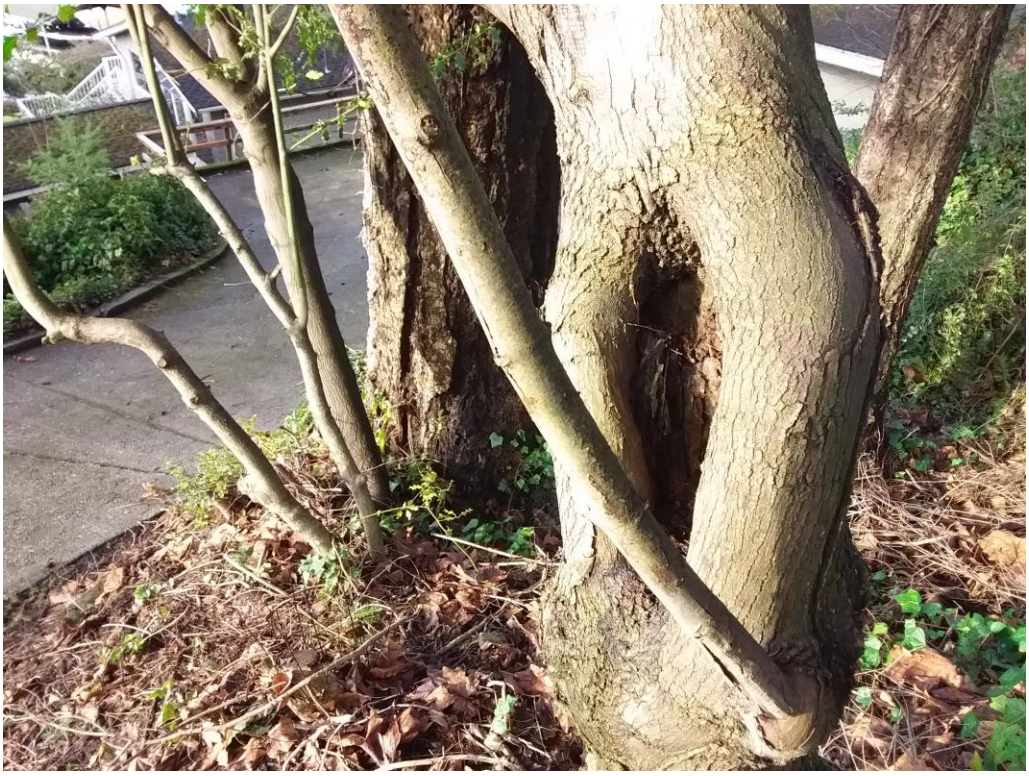

Figure 35. Decayed area at base of another of the #13 maple stems

Figure 36. Decay at the topping point on one of the #13 stems.

Figure 37. Sunscald on the branches coming off one of the #13 stems.

Figure 38. Looking up and SW at the top of the #14 fir.

Figure 39. Canker on the south side of the #19 cottonwood's base.

Figure 40. Canker at the 7’ mark on the #19 tree.

Figure 41. Looking at another structural root with pronounced decay.

Figure 42. Looking south at the area of new concrete east of the #19 tree.

Figure 43. One of the #19 cottonwood roots pushing up against the entry drive curb.

Figure 44. Decay at the base of the #20 cottonwood.

Figure 45. Looking ENE up the entry drive showing the base of the #21 fir and the #22 cedar at the north side.

Figure 46. Looking east at the base of the #24 maple coming through the retaining wall.

Figure 47. Looking SW at the #28 madrone going through the #26 maple.

Figure 48. Roots of the #30 cedar pushing up against the driveway.

Figure 49. Area of new concrete east of the #30 and #31.

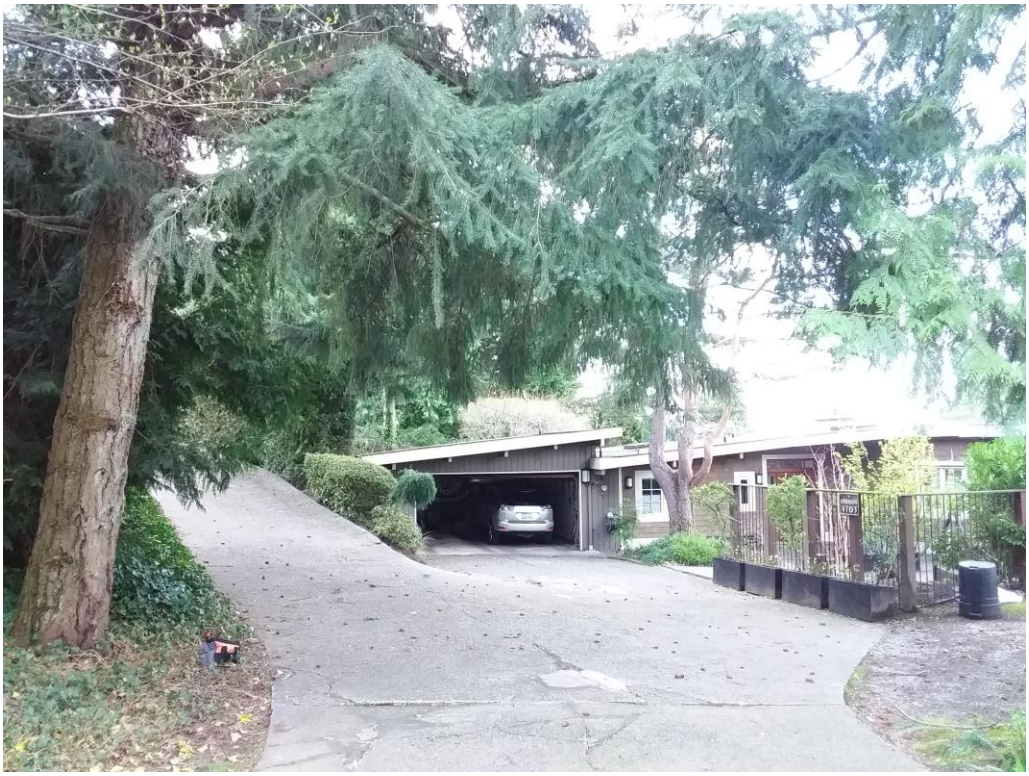

Figure 50. Looking south at the #32 fir extending over the driveway

Figure 51. The matrix used to estimate the likelihood of a tree failure impacting a specific target.

Likelihood of Failure	**Likelihood of Impacting Target**			
	Very Low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat Likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat Likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat Likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Figure 52. Risk rating matrix showing the level of risk as the combination of likelihood of a tree failing and impacting a specific target, and severity of the associated consequences.

Likelihood of Failure and Impact	**Consequences**			
	Negligible	**Minor**	**Significant**	**Severe**
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low