Superior NW Enterprises

April 24, 2020

**Project**: Pre-construction assessment for lot re-development at 4220 91st Avenue SE, Mercer Island, WA. Parcel number 4457300070.

**Contact**: Taylor and Molly Graham
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**Objectives:** Evaluate degree of impact for three neighboring firs and establish criteria for their preservation. Assess dying hemlock for risk.

**Description:** The rear yard of the subject parcel contained a number of large evergreens which had contiguous canopies with those in neighboring yards as of 2009 (Figure 1). The majority of these trees were cleared as of 2012 by previous owners and a lawn was planted (Figure 2). The rear yard was more formally landscaped in 2015 with a large, clearly established planting bed stretching across the SE corner (Figure 3). The last interior evergreen was removed by 2017 most likely in preparation for selling the property (Figure 4).

The Graham family purchased the 4220 home in April of 2017 and continued maintaining the landscaping as shown in Figures 3, 4, and 5. They have recently decided to build a sport court which will cover the southern half of the rear yard (Figure 6). During the planning intake process the City of Mercer Island's review arborist expressed concern with whether the project would impact the roots systems of the large evergreens on neighboring properties. The home owners contacted Superior NW Enterprises and asked for a formal project impact assessment.

A site visit was made on April 21, 2020 and three trees bracketing the SE corner of the property were noted as being large enough to have root systems potentially extending into the construction impact zone. Their numerical designations are reflected in Figure 7. Diameters were measured at the standard height of 54" above grade (DSH) during the site visit. Distance measurements were made from the bases of the trees to the property lines. Heights were estimated.

1) Douglas Fir (*Pseudotsuga menziesii*) 27" DSH, 80' tall standing 56" S of the south fence and 21' W of the SE fence corner (Figure 8). The tree has a structural fault at the 30' mark and the main leader is offset to the east (Figure 9). There are four larger caliper limbs originating at this point which beginning to form into subordinate spars as shown in Figure 10. The tree appears to be in fair health with average new growth and decent color. This tree is Non-Exceptional under the City definition.

2) Douglas Fir 25" DSH, 75' tall standing 18'S of the fence and about 6' W of the #1 tree. It is in fair condition. Its canopy extends down below the halfway point but is almost entirely in the SW quadrant. This tree is Non-Exceptional under the City definition.

3) Douglas Fir 34" DSH, 90' tall standing 18' E of the east border line and 18' N of the SE fence corner. Tree is in fair condition. Its canopy is fairly evenly spread and extends down below the halfway point. This tree is Exceptional under the City definition.

4) Western Hemlock (*Tsuga heterophylla*) 18" DSH, 65' tall standing near or on the north property line 20' W of the NE corner of the property. The tree is in advanced decline and the upper half of the canopy is dead (Figure 11). It appears mostly live in the 2017 aerial (Figure 12) and mostly dead in the 2019 aerial (see Figure 5). This tree is Non-Exceptional under the City definition.

**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 (see Figure 13). 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 14).

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**Discussion:** The only impact at this site is secondary in nature. Primary area includes the environs immediately within the boundaries of the proposed new construction and the regions within ten feet of those boundaries. No trees are in this zone.

The secondary impact area includes the trees which have root systems extending within the construction impact zone. This region, the Critical Root Zone (CRZ), is a radial area extending out from the tree a distance equal to one foot per inch of diameter. For example, the #1 Fir, with a 27" DSH, has a potential 27' radial CRZ.

Typically intrusion within the Critical Root Zone is strongly discouraged by the tree care industry. However 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 15 below illustrates the relationship.

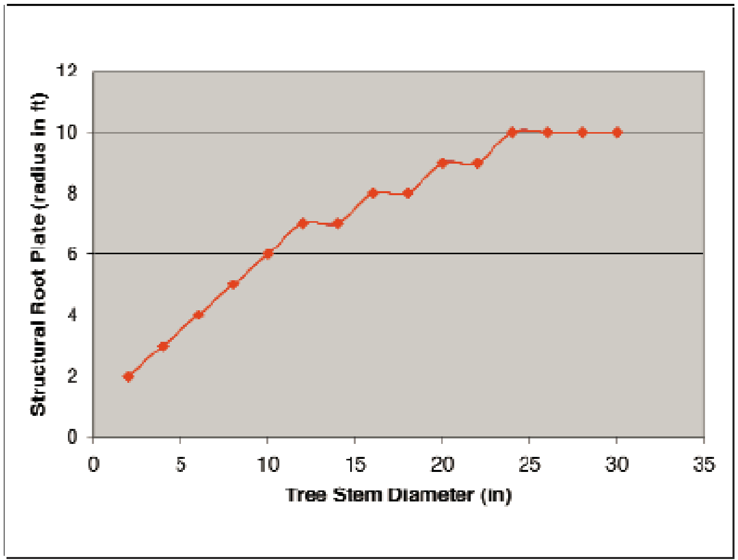


Figure 15. Size of the Structural Root Plate in relation to tree stem diameter. Note that the SRP levels off at 10' for any tree over 24" in diameter. (Coder 1996)

In the case of the #1 tree mentioned above, the excavation for the proposed sport court, including that of the infiltration trench, could come as near as 9.5' to the base of the tree. From Figure 15 the Structural Root Plate for a 27" DSH tree is given as the full 10' so the excavation technically slices through the edge of this tree's SRP.

Because of the work which happened between 2009 and 2012 when the large trees in the yard were removed and their roots obviously ground out (because no stumps are present) and especially from the work done around 2015 to create the large planting bed it is likely that this Douglas Fir experienced some level of root disturbance. It is hard to tell whether the tree's structural roots were damaged or their growth retarded from the ground work but based on observation it is more likely than not.

The other two trees stand far enough away that there is no chance to interfere with their SRPs.

The chart shown in Figure 16 below is used to determine what percentage of a tree's Critical Root Area will be affected by trenching type incursion. In general trees can sustain losses of up to 30% of the overall area within their CRZ without having long term detrimental results.

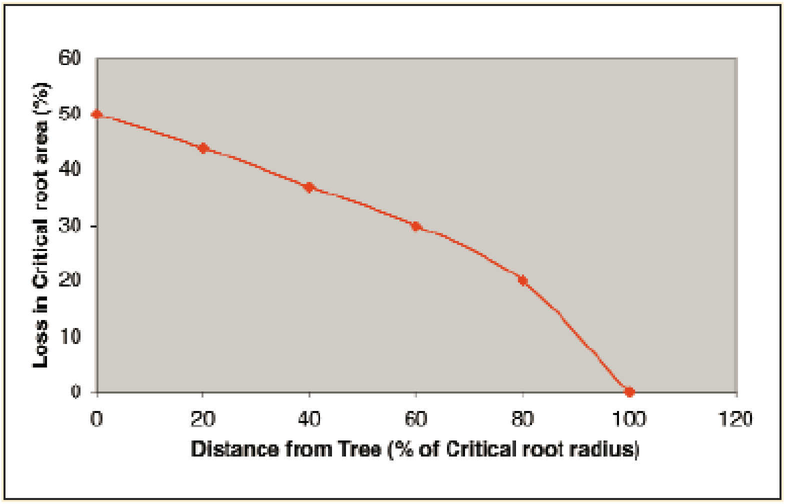


Figure 16. Chart giving the loss in critical root area as a function of the radial distance to the CRZ disturbance. (Coder 1996)

Using the #1 fir again as the example, with the excavation being 9.5' from the tree's base and it having a 27" DSH, there would technically be impact at a linear distance equal to 35% of the fir's CRZ (9.5'/27'). The chart shows that this roughly equates to a potential 40% loss of the tree's Critical Root Area (CRA). If this was the first impact to a pristine rooting space it would be well beyond the maximum recommended impact guideline.

However, as it is more likely than not that the tree has experienced two disturbance events within the last ten years; the realistic impact on the tree should be significantly less. Generally speaking when large evergreens grow in close proximity they do not have as expansive of root systems as would be expected from the literature. When the original removal and grinding event occurred this tree appeared to have four other large trees quite close to it, two of which were probably less than 15' way just over the fence. Grinding their stumps and roots would have most likely limited the subject tree's roots system to no more than five feet beyond the fence line.

It is difficult to tell from the aerials whether the landscape bed was full established in the original event but as of 2015 it clearly shows. When prepping and developing such a bed the ground is often tilled and roots removed in the area in expectation of creating an easier planting environment. It is rare that landscape crews take the time to protect, or even recognize, existing root systems of neighboring trees. As this bed extends right up to the fence and is full of younger landscape plants it is more likely than not the majority of the #1 trees roots system north of the fence was severed.

The fir has had five years to retake the space but it is doubtful that its root density is pronounced in the bed area more or less in the further reaches of the yard. All things taken into account it is much more likely that this tree will suffer root losses closer to 15% of its existing Critical Root Area and should not be expected to suffer long term detriment to its growth.

The #2 Douglas Fir stands 23' south of the excavation cut, and with a 25" DSH, should have little to no net loss of CRA due to construction.

The #3 fir has a theoretical 34' radial CRZ and the east side of the excavation will be 23' off its base. From the chart in Figure 16 this corresponds to a maximum 28% CRA loss. Taking into account all the previous disturbance events it is much more likely that the real time impact will be considerable less. This tree should experience little to no long term detrimental effects from the proposed project.

**Risk Assessment**: At this point in time the #4 hemlock is not so much at risk of falling over as having a large section of its upper column break free. When hemlocks go into these rapid decline spirals the structural integrity of their dead/dying sections are significantly compromised. It is extremely common for them to break free. Thus the hemlock has a **probable likelihood of stem failure**. The subject home and the northern neighbor's home are less than 45' from the hemlock so are within range of a failed piece. A failed section has about an equal chance of falling in the backyards of either home without hitting. This gives a spar a **medium likelihood of striking** a significant target making it **somewhat likely to fail and impact**. If the spar does fail and hit it would cause **significant consequences**. Therefor at this time the hemlock would be characterized as having a **moderate risk** component.

By next year this tree's circumstance will change considerably. Because of how fast they degrade the entire tree would have a **probable likelihood of failure** and a case could be made for it being classified as **imminent**. The larger section would place two more homes in range giving the tree a **high likelihood of striking** a significant target making it **likely to fail and impact**. This will shift the tree into the **high risk** category.

More importantly, by next year the tree's lack of structural cohesion will make it unsafe for a climber to enter.

**Recommendations:** The #4 hemlock should either be removed entirely or at least have the dead portion excised at this time. This arborist does not deem it safe to wait another year to deal with the tree. It also makes the most sense to deal with it during the proposed construction project as much of the client's back yard will be torn up anyway.

To ensure that no destabilization event will occur in regards to the #1 Douglas fir either the project should be shifted at least 6" to the north or some form of exploratory work should be done prior to onset to discover whether roots are present in the excavation zone. The home owner and/or contractor can decide which route is easier to pursue.

Typically 6' chain link fencing is installed to designate no impact zones and is placed at the distance proscribed by the City of Mercer Island for non-incursion. In this case, based on the analysis performed above, the protection fencing should be set 5' west of the east property line for the width of the project on that end. This fencing will either be set at 5' from the south fence if no structural roots (those greater than 2" caliper) are found at this distance or 5.5' if the project is shifted north. This fencing cannot be moved without arborist oversite at any time during the duration of the project.

Post construction it may be beneficial to deep root feed the #1 tree.

**Waiver of Liability** Because the science of tree risk assessment is constantly broadening its understanding, it cannot be said to be an exact science. Every tree is different and performing tree risk assessment is a continual learning process. 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 the Taylor and Molly Graham, their contractor, and their designated representatives only. It may not be reproduced, used in any way, or disseminated in any form without the prior consent of the clients concerned.

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Qualified Tree Risk Assessor
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Figure 1. Aerial photo from 2009 showing the heavy tree canopy in the 4220 yard.


Figure 2. Aerial photo from 2012 showing the trees removed from the rear yard of the 4220 property. The angle of incidence of the satellite puts the tops of the neighboring trees within the yard.


Figure 3. Aerial photo from 2015 showing the clearly landscaped section in the SE corner of the subject yard. Note the evergreen tree in the west corner of this area.


Figure 4. Aerial photo from 2017 showing the missing evergreen at the west corner of landscaped region. Also note that at this time the hemlock is still green (yellow arrow).


Figure 5. Aerial photo from 2019 showing the clearly dying #4 hemlock (yellow arrow).

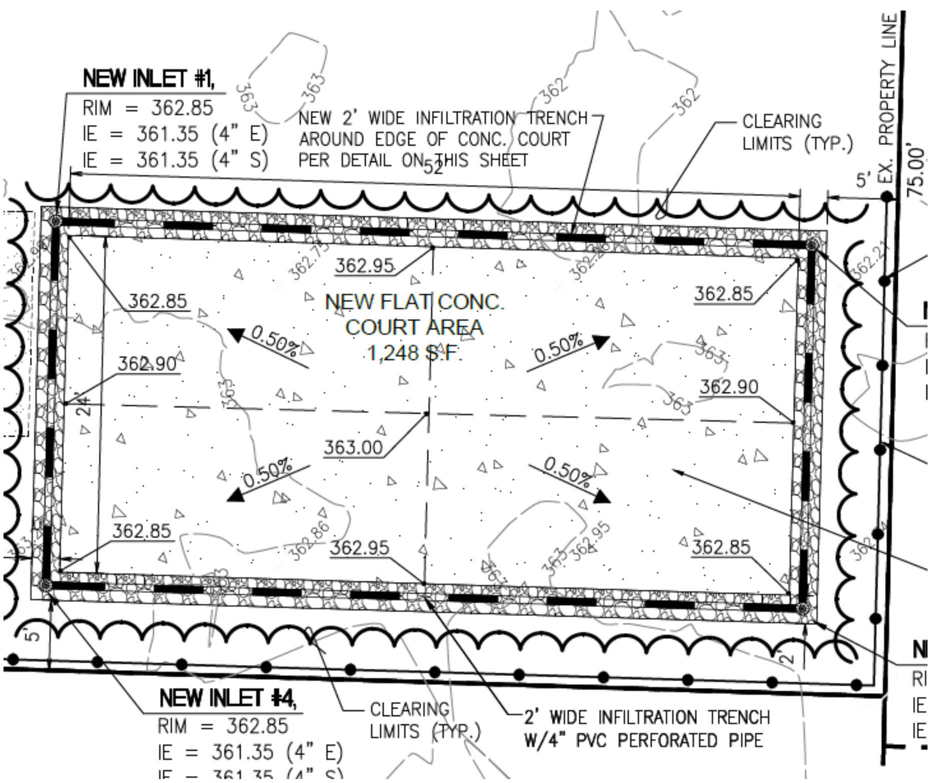


Figure 6. Excerpt from the survey plans showing footprint for proposed sport court.


Figure 7. Aerial showing rough location of subject trees (labeled in white).

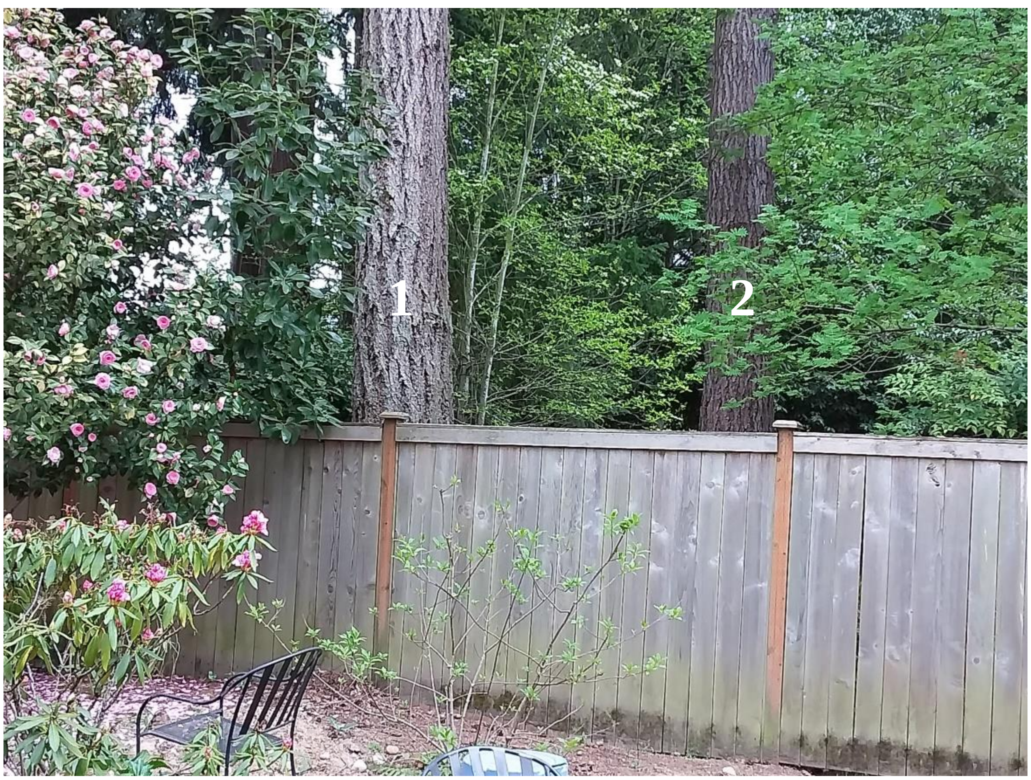


Figure 8. Photo taken during the April 2020 site visit showing the location of the #1 and #2 Douglas Firs standing in the southern neighbor's yard.

Figure 9. Photo taken during the site visit showing the structural fault in the #1 fir.

Figure 10. Close up of the area boxed in Figure 9 showing the limbs which are beginning to convert to subordinate spars.

Figure 11. Photo showing the upper canopy of the #4 hemlock. Tree is in advanced decline and should be mitigated this year.

Figure 12. Aerial photo close up (circa 2017) showing the still viable condition of the #4 hemlock. There is no sign of dieback at this time.

Figure 13. 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 14. 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 |