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Introduction

The process of evaluating tree health and condition involves gathering information in the field, determining the significance of that information and producing a report of the findings. Many reports are the product of periodic ongoing monitoring of a developing situation; as is the case at Chestnut Trails and over time, some repetition in explanatory information is inevitable.

In producing and explaining the findings, each report is intended to be readily understood and able to stand alone, with no further reference being required by either the first time reader or the reader of multiple previous reports.

Each report contains the following sections;

- **Overview** Describes the events that precipitated the initial evaluation and identifies the subject, owner and location.
- **Tree Inspection and Risk Assessment** Containing an explanation of the field work techniques and an outline of methods and instruments used in analysis and an explanation of the Risk Assessment system.
- **Observations** Gives site and tree specific information and commentary.
- **Conclusions** An interpretation of the field work observations, testing and analysis, with recommendations for treatment.

Overview

Chestnut Trails was developed within several Native Growth Protection Areas. The areas containing pre-existing mature and semi mature trees form buffers that surround the homes of Chestnut Trails. They are an integral part of the community landscape providing natural habitat appreciation with informal walking trails that provide recreational opportunities and add to the overall livability of the community.

In part because of the size, age, condition, location, and exposure of the trees; tree failure has occurred in the past. In an effort to assess the risk associated with the trees and to facilitate risk management decisions the trees in the buffers have been periodically inspected. The inspections have taken place over an 18 year span with the first evaluation being carried out in 1997.

The periodic assessments of the trees takes place so that representatives of the community can act to best manage the assessed risk associated with the trees, minimize harm, and implement their duty of care. This is the report of the periodic inspection which took place during the latter part of January 2015.

Tree Inspection and Risk Assessment

To develop an accurate picture of tree health and condition, information must be gathered about the multiple, changeable, factors which influence tree vitality and stability. Vital, healthy tree growth is the result of a complex association of internal and external influences and to consider each tree as an isolated entity is to fall short in understanding the whole picture. As a practical matter, information must be gathered and structured in the

best way to communicate the results of the observations and to impart any recommendations for treatment.

Individual tree inspection begins at ground level; tree genus and species is determined and soil quality, rooting conditions, soil level, irrigation and drainage characteristics are observed. Soil is a living micro-system that relies on an active working relationship between structural and living organic components. In an urban setting the structural condition of the soil is most commonly adversely affected. Alterations to physical soil structure will have an effect on the functions of the living soil components.

The quality of the soil may be assessed in its ability to contain and disperse available moisture and nutrient and the level of soil compaction may be tested to evaluate the aeration capacity of the soil. Some soil types are easily compacted and although they are high in nutrient quantity, little nutrient is available to the growing tree. Compact soils also cause problems by restricting the trees ability to discharge the gasses produced as part of the growth cycle.

The visible parts of the tree, the trunk, branches and leaves live in balance with the unseen roots. Damage to the soil leads to inhibited root growth and causes a lack of vitality and decline within the tree as a whole. Soil compaction may be the result of short term heavy or long term frequent traffic in the root zone. The effects of soil compaction may not become apparent in the tree for decades following the initial compaction event.

If signs of stress are present, a soil test may be made to assess the fertility of the soil. Testing establishes the presence and degree of vital nutrients and micro-flora. Vital soil is essential to vital tree growth, the presence of nutrients and organisms within the soil mean that growth can continue. An imbalance of

nutrients can cause poor vitality; often exhibited by leaf discoloration, distortion or lack of annual growth. Poor nutrition will slow growth can diminish the trees natural defense mechanisms and expose the tree to disease.

In nature, few tree species grow alone; the forest is their natural and protected setting. Whether native or introduced, regardless of a trees' origin, trees in a landscape setting demand special attention. Although bound by the genetic code of its predecessors each tree is also the product of its local environment in terms of health and structural form.

Looking at the overall picture, the health and condition of the soil, turf and other plants and trees can reveal the cause of disease, or indicate potential problems. The presence of certain species of fungus can indicate decay. Decay fungi may destroy support tissues and leave conductive tissues unharmed. The tree may appear healthy and continue to grow until the internal decay outpaces the new outer growth whole tree collapse can result.

A root crown examination may be necessary if root decay is suspected. By removing the soil at the base of the tree, the location, health and condition of the absorbing and support roots can be determined.

In the primary examination of the root crown and trunk a mallet is used to test for loose bark. Bark lifting can indicate dead or hollow areas and give signs of the presence of decay in the root crown zone and at the base of the trunk. The mallet may be used to "sound" for decay but has limited reliability. If decay is suspected the tree will be tested using the Resistograph. Where Resistograph tests were made a more detailed explanation and an interpretation with illustrations is given later in the text.

The type of decay and its effect on the stability of the wood depends on the species of fungus involved. Soil and root tissue samples may be taken to determine the cause of disease by laboratory testing.

The inspection continues with an evaluation of the tree crown, first by eye or with the use of binoculars then, if necessary, by climbing into the canopy of the

tree. The color, size and condition of the leaves, trunk, branches and twigs are assessed. The shape and formation of all the trees components give information about health, vitality and structural strength. The crown density, the amount of live growth on each stem, and past and current growth extension, indicate current health and reveal previous problems. Changes in growth rate in past growth may indicate prior disease or injury.

An evaluation of the general growth habit will reveal any problems related to vigor, or the genetic component of tree growth. Previous treatments such as pruning or cabling are observed, the quality of the work, and its effect on the tree is assessed. Any growth abnormalities are noted: weak limbs, discolored or missing bark, cracks or cavities in branches or trunks. Indications of disease are observed within the canopy of the tree, disease may be indicated by leaf blight, leaf loss, poor vitality, stem canker, fungal growth or insect and bird activity.

Trees produce adaptive growth to compensate for the stress related to growth and injury. The shape and formation of limbs and trunks can reveal the ability of the tree to compensate for weakness or may indicate internal problems that could lead to limb or trunk breakage. The interpretation of these changes in form is part of a growing body of knowledge pioneered in Europe and adopted across the globe. The knowledge is not new but the application of that knowledge in risk assessment is in the forefront of progress in understanding how trees

compensate for stress. Research into stress-loading of trees and materials testing of wood structure has led to the development of systems of structural evaluation based on the principals of bio-engineering.

In many situations the results of the Tree Inspection are used as the basis of a Risk Assessment. The extent and depth to which the processes described above are followed depends on the scope of the assessment. For example; whether a single, high value tree next to a popular meeting place is the subject of the inspection or whether groups of trees in a relatively little used area of a community are of concern. Where large groups of trees are evaluated and are in similar condition and circumstances, group Risk Ratings may be applied.

Tree Risk Assessment

The assessment of risk in trees involves taking the information gathered during the Tree Inspection phase to determine a probability that all or part of a tree will break or fail. The Risk Assessment protocols also assess the risk that the tree failure will harm someone or something.

The method is outlined in the manual; ***Tree Risk Assessment in Urban Areas and the Urban Rural Interface.*** The manual forms the basis of the ***Tree Risk Assessment Course and Certification*** process.

Tree Risk Assessment is used to identify hazardous situations before damage or injury occurs. Risk Assessment is also used to facilitate risk management specifically to manage the risk associated with the retention of trees, using cultural practices to maintain the risk at an acceptable level. Risk Assessments are undertaken periodically by Certified Tree Risk Assessors as a matter of due diligence to allow the owner/ manager of the trees to meet a standard of care.

The method assesses three components and attaches a numeric value:

- **Probability of Failure (1-5 points)**
- **Size of the Defective Part (1-3 points)**
- **The presence and rate of occupation of a target. (1-4 points)**

Each of the three categories has been given a rating based on an assessment of a multiplicity of factors in each component.

The components are dealt with individually and the ratings are explained below.

Probability of Failure (1-5 points)

1. Low
2. Moderate
3. Moderately High
4. High
5. Extreme

The Probability of Failure rating represents an assessment of the condition of the tree and the likelihood of failure during ordinary conditions and predicable extraordinary conditions such as prevalent local storm conditions. Predictable tree failure is usually due to structural weakness revealed by a combination of injury, decline, disease and defect, or changes in exposure. However, trees are shedding organisms, they periodically drop parts of themselves to maintain defense against disease and to provide for growth, this periodic shedding poses an element of risk and not all periodic shedding is predictable.

Size of Part (1-3 points)

The size rating is based on the diameter of the part.

1. Up to 4”
2. Between 4” to 20”
3. Greater than 20”

Target (1-4 points)

The target is rated on use and occupancy. The Target ratings are shown with an example.

1. Occasional use [trails]
2. Intermittent use [picnic/parking areas]
3. Frequent use, secondary structures [storage areas, frequently used structures]

4. Constant use, structures.[residences, buildings used for a number of hours each day, year round]

The Overall Risk Rating and Action Thresholds (3-12 points)

The Risk Rating is the sum of the three categories a number from 3 to 12 an interpretation of the rating and a discussion of the implications is provided in the Table Appendix One below:

The Overall Risk Ratings Categories and Action Thresholds

Rating	***Category***	***Interpretation and Implications***
3	Low 1	Insignificant- no concern at all.
4	Low 2	Insignificant-very minor issues.
5	Low 3	Insignificant-minor issues not of concern for many years yet.
6	Moderate 1	Some issues but nothing that is likely to cause any problems for another 10 years or more.
7	Moderate 2	Well defined issues-retain and monitor. Not expected to be a problem for at least another 5-10 years.
8	Moderate 3	Well defined issues-retain and monitor. Not expected to be a problem for at least another 1-5 years.
9	High 1	The assessed issues have now become very clear. The tree can still reasonably be retained as it is not likely to fall apart right away, but it must now be monitored annually. At this stage it may be reasonable for the risk manager/owner to hold public education sessions to inform people of the issues and prepare them for the reality that part or the entire tree has to be removed.
10	High 2	The assessed issues have now become very clear. The probability of failure is now getting serious, or the target rating and/or site context have changed such that mitigation measures should now be on a schedule with a clearly defined timeline for action. There may still be time to inform the public of the work being planned, but there is not enough time to protracted discussion about whether or not there are alternative options available.
11	High 3	The tree, or a part of it has reached a stage where it could fail at any time. **Action to mitigate the risk is required within weeks rather than months.** By this stage there is not time to hold public meetings to discuss the issue. Risk reduction is a clearly defined issue and although the owner may wish to inform the public of the planned work, he/she should get on with it to avoid clearly foreseeable liabilities.
12	Extreme	This tree, or apart of it, is in the process of failing. **Immediate action is required**. All other less significant tree work should be suspended, and roads or work areas should be closed off, until the risk issues have been mitigated. This might be as simple as removing the critical part, drastically reducing overall tree height, or taking the tree down and cordoning off the area until final clean up, or complete removal can be accomplished. The immediate action required is to ensure that the clearly identified risk of harm is eliminated. For areas hit by severe storms, where many extreme risk trees can occur, drastic pruning and/or partial tree removals, followed by barriers to contain traffic, would be an acceptable first stage of risk reduction. There is no time to inform people or worry about public concerns. Clearly defined safety issues preclude further discussion.

Observations

The Native Growth Protection Areas (Buffers) at Chestnut Trails consist of stands or groups of indigenous conifers in the form of semi-mature Douglas fir (*Pseudotsuga menziesii*) with some Western Hemlock (*Tsuga heterophylla*), Western redcedar (*Thuja plicata*), Red Alder (*Alnus rub*ra) and Bigleaf Maple (*Acer macrophyllum*).

The issues in relation to the trees in the buffers at Chestnut Trails are well defined and documented. Prior inspections have identified and isolated root disease sites and identified individual trees in proximity to those sites that were prone to failure. Trees that had a high probability of failure and that represented a high risk have been removed or cut to snags to avert damage or injury. Since the original evaluation in 1997 the process of Hazard Evaluation has evolved and the current Best Management Practice is provided by the Tree Risk Assessment process. The process of Risk Assessment is described in the preceding section.

In 2013 it was recognized that the situation at Chestnut Trails would require an adaptation of the Risk Assessment system to identify high risk trees en-bloc. It was decided to attribute risk ratings for groups of trees in similar, condition and location. Trees in Risk categories, High 1 and High 2 were identified for special attention or action within the annual evaluation cycle.

High 1	The assessed issues have now become very clear. The tree can still reasonably be retained as it is not likely to fall apart right away, but it must now be monitored annually. At this stage it may be reasonable for the risk manager/owner to hold public education sessions to inform people of the issues and prepare them for the reality that part or the entire tree has to be removed.
High 2	The assessed issues have now become very clear. The probability of failure is now getting serious, or the target rating and/or site context have changed such that mitigation measures should now be on a schedule with a clearly defined timeline for action. There may still be time to inform the public of the work being planned, but there is not enough time to protracted discussion about whether or not there are alternative options available.

In the past, the primary mode of tree failure at Chestnut Trails has been windthrow of whole trees. Failure was largely due to the effect of high winds on exposed trees with decayed roots. Past inspections have identified and confirmed root disease sites and called for the removal of exposed trees in proximity to those sites. High target zones have also been identified and are shown on the sketch plan of the site. The high target zones contain trees adjacent to residential property that are exposed. The sketch plan has been updated to show the results of the 2015 Tree Inspection and Risk Assessment.

Since the inspection of February of 2011 a single significant tree failure has taken place. The mode of failure was atypical in that the tree snapped at approximately 10’ in height. Examination of the remains of the tree and the stump show that internal decay was present in the trunk; indications are that the tree, although severely decayed, was still growing at the time of failure.

A new and useful addition to the Tree Inspection process is the inclusion of specific concerns that homeowners have observed relative to tree or site condition. Those specific concerns have been communicated by the Brink Property Management representative and are addressed below. The inclusion of homeowner observations is particularly useful because the homeowners are uniquely positioned to observe and monitor changes in tree condition. Early identification of potential disease is the key to managing potential problems. In addition, some clarification has been requested in respect of specific details. The questions and responses are listed at the end of the report.

Also new to this years report is the inclusion of a photo log. The log is to monitor visual condition with a series of photos of the same subject taken from the same angle. Using this method along with on site observations will facilitate assessment of comparative tree condition.

Conclusions and Recommendations

The periodic Tree Inspection and Risk Assessment of the trees at Chestnut Trails took place during the latter part of January 2015.
The tree work that was recommended following the last inspection has been completed and trees have been removed or reduced to high stumps to form wildlife snags.

In general the trees as a group appear to have continued a general resurgence in health. This ongoing improvement in health as shown by growth extension, leaf color and density may be attributed in part to the identification and removal of diseased trees. Tree health improvement is likely also due to a further acclimatization of the remaining trees to the site conditions; also to an overall maturation of the site conditions and an adjustment of soil quality, tree rooting environment which occurs naturally over time.

A homeowner at 3004 200th Pl. SE has expressed concern about the condition of trees in the buffer behind the residence. The trees are shown in the photograph at left, located on the left side of the home. These two trees are dead and have been marked with fluorescent paint. They may either be felled or reduced to 20' snags for wildlife habitat. They are located on the revised sketch plan. Following sounding a Douglas fir in disease center D5 was deemed to have extensive internal decay at the base and was marked for removal. Two Alders located in proximity to the play area on 201st Pl. SE were also marked for reduction or removal. Although these trees have previously been identified as having high value as habitat; their condition has deteriorated to the point where they now pose a significant risk.

Past inspections have noted the condition of a Douglas fir behind homes on 32nd Ave. The tree exhibits die-back in the leader. It was noted that die-back of this kind can occur as a result of drought or a change in moisture availability. It was also noted during the 2014 inspection that tip die-back has not advanced and that the tree appears otherwise healthy. The 2015 inspection concurs with that of 2014 and is illustrated by the photographs above. The die-back in the leader has abated and tree health is improved.

Where there is a likelihood of failure there is the possibility of injury and damage and the associated exposure to litigation. Trees, although generally long lived, are organic structures with a finite life cycle, which includes senescence and decline. They are also shedding organisms that periodically cast off parts to manage disease and to provide for growth. Each of these elements involves a degree of risk. Much of the risk can be managed by cultural techniques such as pruning or additional structural support. To remove *all risk* associated with trees would call for the removal of all trees. As a solution, wholesale tree removal is neither prudent nor practical. To live with trees is to assume some level of risk. The degree of risk that is acceptable must be determined by the owner or manager of the property on which the tree resides. The goal is to provide a

conservative assessment of the current condition of trees with an assessment of the associated risk and recommendations to aid in decision making.

Tree Inspection should not be considered as a one time event. Trees are dynamic organisms growing, aging and responding to multiple internal and external influences over time. In order to fully appreciate the effects of change continued monitoring through periodic inspection is necessary.

Monitoring the trees at Chestnut Trails remains important. The site has a history of tree failure and although there has been continued improvement in overall health and condition, some trees are showing signs which may indicate early stage decline. These indications may also represent temporary setbacks due to local environmental alterations including climatic change. Continued monitoring will help assess the significance of the symptoms over time. The next inspection should be scheduled for January of 2016.

Other Issues

Concerns have been raised about soil disturbance due to Mountain Beaver. The disturbance observed is likely the product of the local environment changing and becoming conducive to Beaver activity and habitat.

Mountain Beaver habitat is characteristically dominated by coastal Douglas-fir and Western Hemlock (*Tsuga heterophylla*). Within this zone, Mountain Beavers often favor moist ravines and wooded or brushy hillsides or flats that are not subjected to continuous flooding. Although frequently found near small streams, they are not limited to those sites except in more arid regions. Active burrows may carry water runoff after heavy rains, but Mountain Beavers will vacate burrow systems that become flooded. Mountain Beavers do not require free water; they obtain adequate moisture from the vegetation they eat. Mountain Beavers occupy mature forests usually in openings or in thinned stands where there is substantial vegetation in the understory. They usually leave stands where the canopy has closed and ground vegetation has become sparse. Preferred habitats in forested sites are often dominated by Red Alder (*Alnus rubra*), which the animals promote by preferentially feeding on conifers and other

vegetation. These sites are often dominated by an understory of Sword Fern (*Polystichum munitum*), a preferred food of Mountain Beavers. Stands of Bracken Fern (*Pteridium aquilinum*) are also favored by Mountain Beavers. Preferred shrub habitats include Salmonberry (Rubus spectabilis), Huckleberry (*Vaccinium parvifolium*), Salal (*Gaultheria shallon*), and Oregon grape (*Berberis nervosa*). Small trees often found cut by Mountain Beavers include Vine Maple (Acer circinatum) and Cascara (*Rhamnus purshiana*).

Although dramatic, damage caused by Mountain Beaver is rarely destabilizing for mature trees. Damage occurs to smaller trees, seedlings and saplings are stripped of bark or taken as food supply. As the local environment changes with a progression of species and alterations of use in the area the Mountain Beaver will likely re-locate to find the preferable site conditions described above. This process may be hastened by the development and maintenance of paths in areas of Salal.

Replacement plantings; should not be located in known Mountain Beaver territory. The gradual introduction of disease resistant or immune species should commence with the planting of 4' to 6' Western redcedar *(Thuja plicata)* in openings in the stands of trees. Western redcedar is a native species commonly available and relatively inexpensive. More information is available here. http://icwdm.org/handbook/rodents/MountainBeaver.asp

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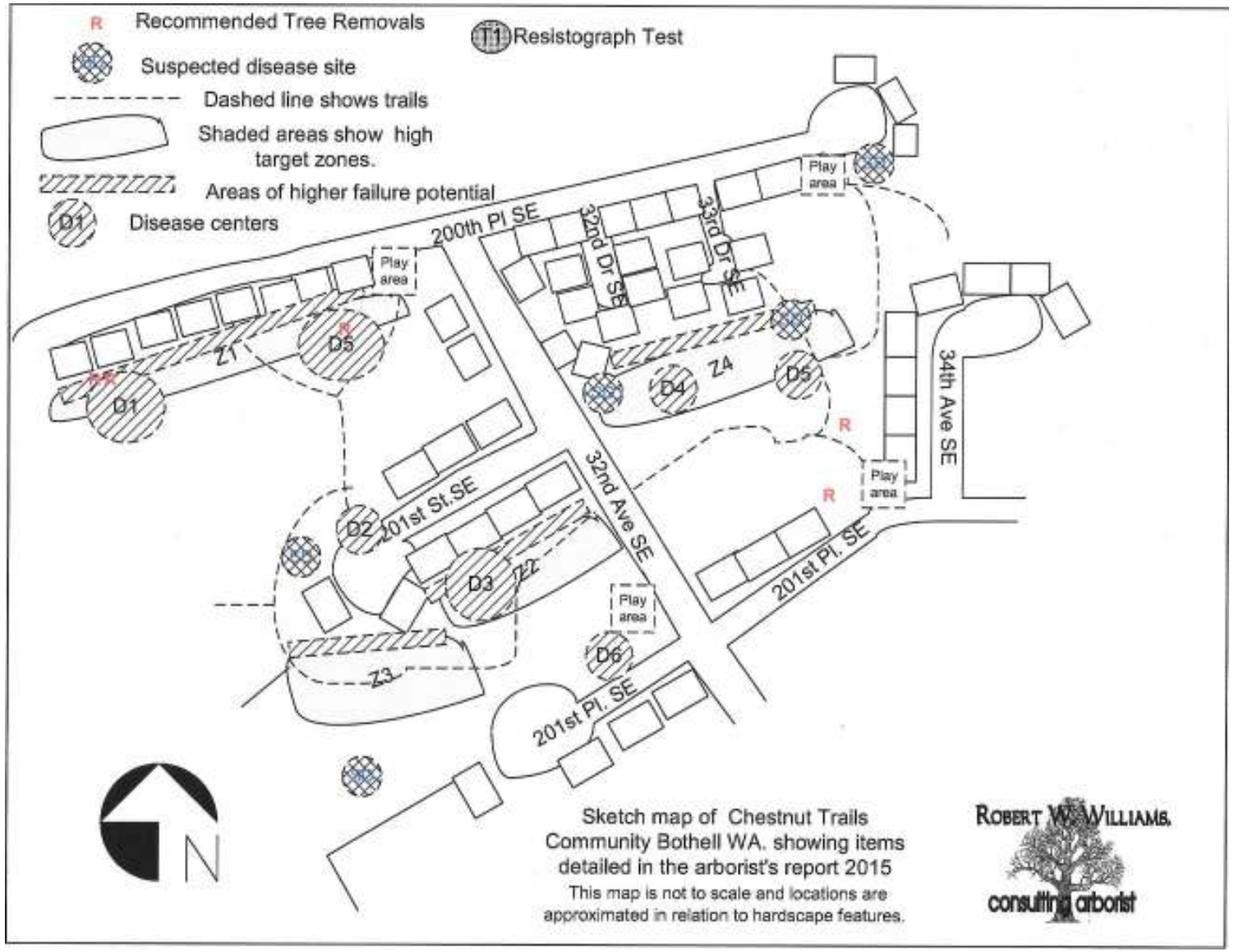
Photo Log

2014

2015

2014

2015


R Recommended Tree Removals
T1 Resistograph Test
Suspected disease site
Dashed line shows trails
Shaded areas show high target zones.
Areas of higher failure potential
D1 Disease centers
200th Pl SE
32nd Dr SE
33rd Dr SE
34th Ave SE
32nd Ave SE
201st St. SE
201st Pl. SE
Play area
Z1
Z2
Z3
Z4
D1
D2
D3
D4
D5
D6
R
N
Sketch map of Chestnut Trails Community Bothell WA. showing items detailed in the arborist's report 2015
This map is not to scale and locations are approximated in relation to hardscape features.
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