THE SILVER MAPLE

ON

UNIVERSITY BOULEVARD

VANCOUVER

A

STRATEGY

FOR

REVIEW AND

REPLACEMENT

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CONTENTS

BACKGROUND TO THE REPORT

In or around 1928 a professor of horticulture at the University of British Columbia was an avid proponent of planting up the campus and its environs partially as a teaching tool for the future and partly to better landscape the surrounding streets, parks and campus proper.

Professor Buck chose Silver Maple (Acer saccharinum) an eastern Canadian tree species, fast growing and with upright appearance and smallish leaves for a maple, as the tree to plant on this important entryway to the University. Street tree planting in the west was a relatively new activity and the mature condition and nature of the Silver Maple as a western street tree was then unknown.

In the east once Silver Maple reached early mid-life, it was recognized that the tree had some inherent defects as a street tree due to its weak nature and it ceased to be planted. (Pirone (18) at page 157)

All trees require maintenance. Street trees in particular require ongoing attention, the more so if they are in a confining root and stem location. The maples Professor Buck planted are in a narrow tree lawn on a street whose use has changed dramatically since 1928. Neither the street surface nor the trees have received major maintenance attention in recent decades.

A number of trees have been removed for safety reasons, some have lost major limbs and at least one has blown down on a passing vehicle, a B.C. Transit bus, which was empty of passengers, however, the driver was severely injured.

A very recent inspection conducted on behalf of the Ministry of Transportation and Highways has indicated that there are at least 59 hazardous trees on the Boulevard, possibly more.

Public concern has been raised about the impending loss of the resource and suspicion that it was a precursor to extensive road widening. The accuracy of the tree removal need has also been called into question.

The work has been temporarily stopped for further examination and input from other informed sources. Some further public input is anticipated.

The tree removal work was to be married with a tree replacement program. The choice of appropriate species for replanting University Boulevard is not yet resolved.

This report examines the past and present work regarding the Silver Maples on University Boulevard and makes recommendations for the future.

EXECUTIVE SUMMARY OF THE ISSUES AND OPTIONS

ISSUES:

The most obvious issue is why is the tree work being undertaken and why now? The Ministry of Highways and Transportation have been faced with some longer limbs falling from the Silver Maples over time. This prompted an arboricultural review of the condition of the trees on University Boulevard. Fifty-nine of the existing trees were found to be a present hazard and a program was initiated for their removal. The hazard includes extremely elongated larger limbs putting great strain on weak crotches, mechanical failure of some limbs, loss of vigour, decay in some limbs, root rot conditions and safety for vehicles and pedestrians. It is not an issue of minor columnar, vertical or horizontal decay in large stems as some have suggested. Most, if not all Silver Maple of this age, will present with incipient or active internal decay. It may, however, be a precursor to general decline.

The solution to the present condition of the trees has been suggested as major maintenance and not removal. This ignores the advanced condition of some trees which are now judged by an independent consulting arborist to require removal in some cases. Radical pruning, cabling, tree surgery and similar activities will not render these trees safe over time. The tree is weak wooded and will produce aggressive sucker growth from stub cuts, many of which will be inevitable since there is little branching scaffold to drop crotch prune to. Whatever trees remain, with or without repair, their lifespan will be short and their condition from a safety perspective suspect.

The safety issue is underpinned by the duty of care placed on responsible officials, a degree of accountability not extending to others not directly responsible for decisions made on the public's behalf. The issue of liability will, no doubt, attend any future tree failures and injury. The reasonable man legal test will attend since the issue of the removal and replacement has a chain of evidence reaching back to reports in the 1940's.

Public concern over loss of this important visual asset, seen and enjoyed by many thousands of residents, students, faculty, employees and visitors who have or do use the Boulevard, is to be expected. It is an important link from the city to the campus and endowment lands. It is important to ensure that there is full disclosure to the public of any activity and plans to be undertaken by the various parties responsible for the Boulevard to minimize any misunderstandings as to future intentions.

Tree suitability for this species in this location is an issue since much has been learned about the growth and safety of Silver Maple since they were planted in 1928. It is not now used as a street tree for the reasons of safety discussed in this report.

The number of trees left on the boulevard represent only 61% of the original planting and this will fall to about 50% once further hazard tree removal is completed. The condition of balance of the remaining Silver Maple apart, a replanting program is envisaged for the unplanted spots. This intent will require a design plan and selection of an appropriate species or pallet of species. A recommended list is prepared in this report.

There is an issue of roadway safety since the travelled surface, curbs and street drainage have all been adversely effected by the trees in place. This opens the question of repairing or rebuilding the roadbed and blacktop surface, or parts of it. Such work has the distinct potential of hastening remaining tree decline.

In addition to road repair is the issue of realignment given that use of the road has changed since 1928. The public transit system uses coaches with a width that brings them very close to the trees and allows little room in the second lane for other traffic. The tree lawn is also narrow for wide boled trees. Some building growth has taken place on the University Endowment Lands and a planning process is underway to guide future expansion. This may or may not have an influence on University Boulevard traffic patterns. Decisions made now will be reflected well into the 21st century.

It will be important to develop a clear and explicit management plan for the Boulevard that shapes its future and ensures its maintenance on a time horizon appropriate to its most likely future uses.

OPTIONS:

A number of alternative arboricultural strategies can be applied to the tree resource at this juncture. The trees left standing could remain. This approach needs to recognize the liability that attaches. Reconfirmation of condition and hazard designation could occur and only those hazard trees removed. Extensive pruning will have to be instituted for remaining trees as required. Their long term health will always be doubtful particularly if road work is undertaken.

All of the trees could be removed and a complete replanting undertaken along with a program of street repair, rebuilding or realignment and rebuilding. This option appears to be constrained by funding concerns but is probably the most appropriate.

Between the "do nothing more" option and the radical rebuild and replant option stands a number of viable alternatives.

The preferred option recommended by this writer is in four parts: (i) determine how much road work must be carried out for safety reasons; (ii) determine, to the extent possible, the time horizon and contributing factors that will influence more major roadwork, if any, that is envisaged in the next five years; iii) determine the condition and needs, if any, of the right-of-way utilities; (iv) finalize the assessment of existing tree condition and retention.

Once the engineering considerations are understood then it is possible to plan the replacement program by: i) choosing one or more appropriate species; ii) designing their use, spacing and any supplemental planting in the centre median.

Concurrent with anticipated engineering activity would be the confirmation of existing tree hazard, in part based on the information gathered from recent takedown, and in part on a street reevaluation of hazard criteria so far assigned.

(i) "In tree" examination for retention may well be justified with a bucket truck as a review platform. Radical pruning or cabling is not recommended as a long term solution. (ii) Some corrective pruning, if safe and feasible, will be appropriate for any trees deemed safe to remain at this time. (iii) Once takedown and stump removal is complete, replanting in properly prepared pits will be possible. Replanting pit preparation will have some impact on any remaining trees. This impact along with the street engineering and hazard tree considerations must collectively form the judgement criteria for the retention of any existing Silver Maple. Replanting will also be constrained by the underground utilities and the trolley support system as well as traffic control devices and bus stops. (iv) The present London plane trees should not be retained.

This work should allow for a staged replacement of the Silver Maple and a well designed planting program for University Boulevard on a time horizon that addresses the next street tree planting life expectancy of around 2090.

SUMMARY:

1. Silver Maple (Acer Saccharinum) is a fast growing but weak wooded tree whose undesirable traits outweigh its benefits as a street tree to the extent that it is no longer used for this purpose. The tree may well have been planted with the intention that it would receive annual pollard pruning and not be allowed to develop a large crown.

2. The trees on University Boulevard have received little maintenance in recent years despite repeated calls for the work. Radical tree work on the trees now may reduce risk little and not prolong the life of many trees substantially.

3. A number of existing trees have been classed as hazard trees. Recent experience of larger limbs falling, a major accident involving a transit coach, a comprehensive inspection by a qualified arboricultural team and the condition of some trees on close inspection after recent takedown, confirms the very poor condition of some trees.

4. Present understanding of the tree resource condition may suggest that now is the time to consider complete removal and replacement since any trees allowed to remain will be impacted negatively by any roadway repair, curb rebuilding and new tree planting excavation activity.

5. The choice of replanting species and the timing of replanting should reflect the design needs of scale, shape and final appearance desired for the boulevard, but it should also incorporate the engineering concerns regarding existing street condition and repair, utility uses in the right-of-way and tree lawn width as well as the horticultural criteria that surround good street tree selection. Once planted these trees should be properly maintained. If any existing trees remain, they too will require an active program of maintenance.

INTRODUCTION

While street tree planting is not a new enterprise and has been practised in North America from the mid-1800's on the eastern seaboard, it is a publicly supported activity of more recent vintage in British Columbia. An extensive study of the street system in Vancouver conducted for the Parks Board by Gardner in 1980 (11) suggests that street planting was initiated in 1896 with an approved list of trees and a .50¢ per tree incentive payment by the municipality (at page 11).

Thus, almost 100 years have passed since street tree planting was initiated in Vancouver as a program organized, supported and managed by the city. A wide variety of tree species have been utilized since then. Some, but not all, are to be seen on city streets to this day. As time progressed, fashions changed and more knowledge was gained, some trees were adopted and some rejected. Silver Maple are no longer to be found to any extent on city streets; their demise a function of their weak limbs and aggressive growth.

The trees on University Boulevard are, however, in a different jurisdictional zone than the city. The Silver Maple there have survived the removal and replacement that has occurred in other localities of the city. While they have survived without care in recent decades, almost half have been lost to the ravages of time; removed because of safety considerations.

All trees are a dynamic resource, they progress from youth, through middle age to maturity and then to overmaturity and decline. That same cycle for man is about 3,500 weeks. For the best urban trees perhaps less or perhaps longer up to 5,000 weeks if everything plays in their favour. This is not the case for the Silver Maple on University Avenue. Many of the remaining trees are in decline, most have internal decay in stems or limbs and many have excessive scaffold branch length, placing intolerable strain on crotches that often exhibit bark inclusion and poor mechanical attachment.

The park management and arboricultural professions have not been faced with major, high profile, wholesale, tree replacement programs yet, although cherry decline will precipitate it in Vancouver and Dutch Elm disease that has ravaged street trees in the east will eventually come west.

The general population then, their concerns sharpened by loss of old growth forest, clearcutting practices and wholesale tree removal for some development sites around Vancouver (see Gardner 1993 for a more detailed description) (9) are not preconditioned or predisposed to loss of boulevard trees that, to initial first blush, appear to contribute unique aesthetic virtues to a roadway that has carried the preponderance of university educated residents of Vancouver before the advent of Simon Fraser University.

This tree lined boulevard of great grace and charm is, however, like us all, getting no younger. And, in its twilight years, it is becoming ever more dangerous. The decline can be arrested in some trees from some time with extraordinary measures but is this wise public policy?

There are four main issues. The first is the emotional attachment that many have to the scenic, sensual and systatic feeling of nature that the trees impart to all who have enjoyed the experience of this treed boulevard. This is hard to renounce for many; it is part of their being at UBC.

The second concern is the technical issue of tree condition. Does it warrant the wholesale removal of trees at this time? Are the judgments made correct and the criteria used explicit and efficacious? Is there some interim solution? Can remedial work prolong the trees at reasonable cost with a significant reduction in risk? Is the suggested risk valid and verified? What is the best course of action when viewed in the light of reasoned and informed advice?

The third concern is an ethical one. What responsibilities does a public official have to ensure public safety? There is no doubt that all trees have the potential to fall or for parts to fall on people. A walker in the woods must accept that this may happen. A driver or jogger on University Boulevard may wish to apply a more weighty burden on those charged with maintaining this street. Certainly the courts would apply a telling duty of care on the public organization responsible, particularly if a specific concern about safety had a claim of written evidence that dates from the 1940's and the documented cases of tree failure of late. The reasonable man test would dictate that no person would knowingly retain a hazardous tree without retaining a connected liability.

The fourth issue then, is what management strategy is best, given the present conditions and notwithstanding all that went before? The suggestions or options for tree management cannot be made in isolation. What of the future of the road? What of growth of use on the road? What of the significantly deteriorated condition of the roadway and curbing? What maintenance, if any, is appropriate for any existing trees? What tree replacement should take place now for a future beyond the halfway point in the next century? How best to leave a viable legacy, properly maintained, so that the next time controversy will not be the only mark of management.

ALTERNATE STRATEGIES

The Ministry of Transportation and Highways ("MOTH") had, up to this juncture, adopted the partial removal and replacement strategy, although this may have not been clear to all with an interest in the trees.

As opposition became apparent, a hold was then placed on the work for further consultation with *"a group of experts"*. The work of removing some 59 trees considered hazardous has not been completed with some trunks with branch removal having already occurred on the southside of the boulevard and most of the trees slated for removal on the north side untouched.

Other strategies are or could have been:

(i) radical corrective tree pruning to reduce limb length, coupled with some surgery, general pruning and suspect longer limb cabling as suggested by Fisher (13).

(ii) removal of all trees coupled with comprehensive replanting. This would include removal and replacement of the 20 London Plane trees (Platanus x ne acerifolia x hispanica).

iii) a variation of (ii) above presumably with London Plane as the selected replacement as advocated by Fisher in 1988 (13).

(iv) Removal of every hazardous tree as well as a proportion of the remaining trees, say every third, to retain some of the appearance of the boulevard yet allowing replanting in a progressive manner. Ongoing replacement would continue over a set period.

(v) the last obvious strategy of doing nothing is seen as unacceptable, both now and in the future.

All strategies may or may not further address only the edge tree lawn. No strategy of taking all the trees without replacement is considered. Tree replacement may however be done in conjunction with further planting on the centre boulevard that could yield an enhanced verdant visual image. This would also change the open centre character of the roadway.

All of these options may or may not include upgrading of the roadway surface and curb condition.

The most obvious options are discussed further in the body of the report.

THE BOULEVARD RIGHT OF WAY

The right of way at its inception would have reflected the desire in the twenties to have a grand entry into the university environs.

Space was not at its present premium and the alienation of 100 feet for this boulevard would not have been unduly extravagant. The 36 feet (11 metres) wide centre median was in keeping with designs of the time. However, there is a paucity of allocation in the rather meagre 9 feet (2.8 metres) tree-lawn, given the tree selection and its ability to girth up to 42 inches (1.07 metres) (Gardner Peepre 9(10) at p.56) when one considers that root growth for a tree of this size must be extremely large to counter windblow.

Present day traffic too is allocated little room, only some 5.5 metres for two lanes which was no doubt well adequate at mid-point of the second decade of this century before the advent of public transit vehicles over 8 feet wide.

Two metres (6 feet 6 inches) for pedestrian traffic on either side was probably also adequate before the present day mix of walkers or bikers on machines of material and metal not even invented at planting time of the trees in question.

The centre median is wide even by 1920's standards yet rather sparsely planted at least by present day appearance. One wonders if other uses or much more extensive horticultural use existed in earlier times. Certainly the noted designer, Desmond Muirhead, writing in early 1940's (15) suggested that there were *"highly artificial boulevard plantings ... generally being replaced with heathers which are ideal ...* (at page 43).

The allocation of the right of way to various uses including utilities, trees, sidewalks, pavement, tree lawn, curbing, edge fencing, transit system and roadway lighting or traffic lights at intersections, is a challenge. Present day use may dictate a different proportion of allocation for the needed uses as the street is planned for the mid point in the 21st century rather than the early part of the 20th century.

ENGINEERING CONSIDERATIONS

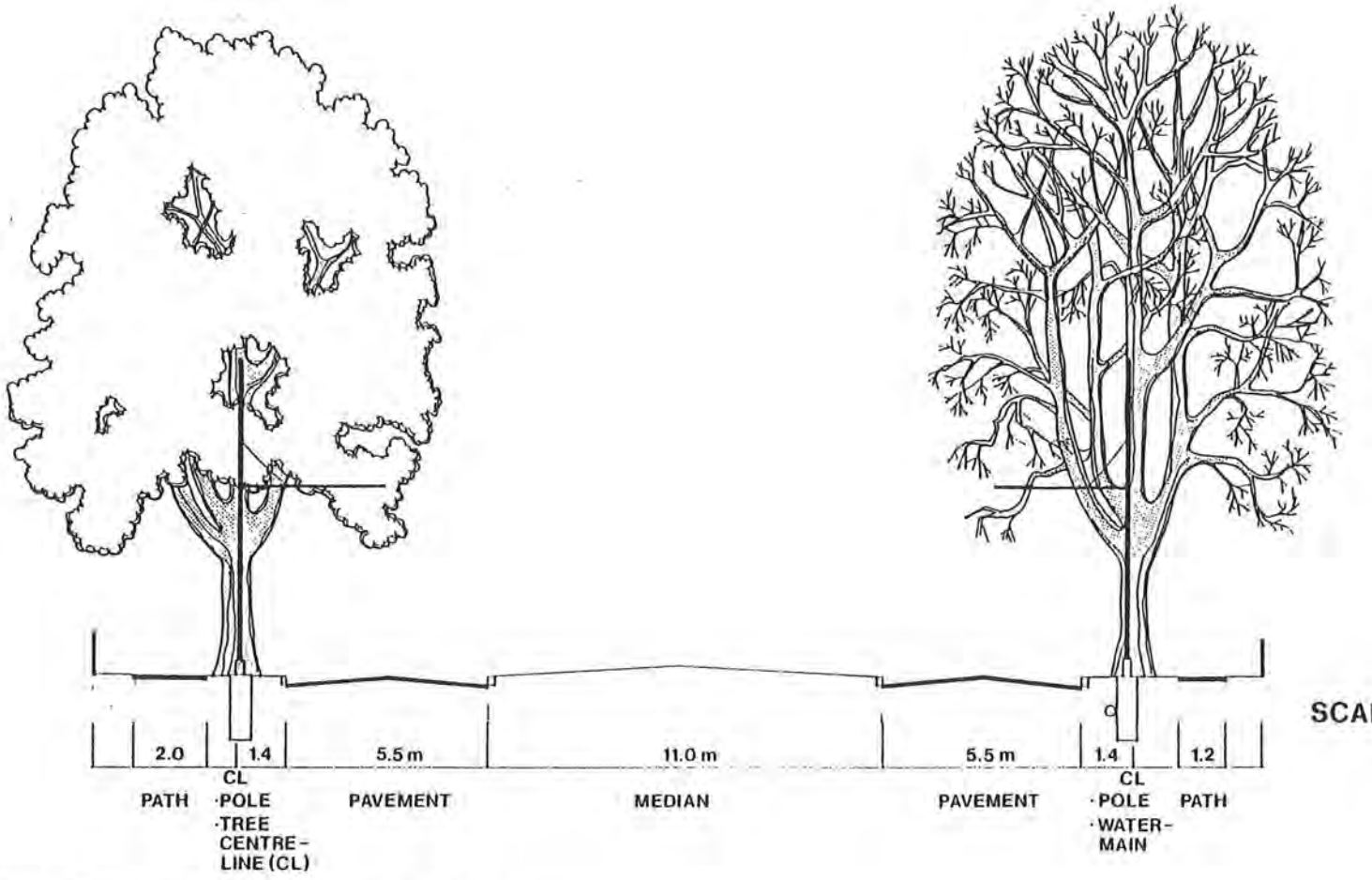
The 1981 Gardner Peepre report (10) at page 6 provides a cross section of the right of way (seen here as plate 1). It suggests that the north side tree lawn contains a water main. The condition of this main, its criticality of use and tree impact on it as a result of aggressive root growth is not known.

The same report recognized (at page 42) that the interaction between the trees and the built roadway was considerable and suggested that curb and pavement rebuilding should be addressed since such decision at that time should predicate future tree work and replacement.

The street is now a series of broken or sunken curb in part due to heavy vehicle traffic, lifted curb and blacktop due to tree roots, significant heavy rain ponding on the road surface, periodic damage to the cycle and pedestrian pathways and trees growing in a narrow tree lawn width (2.8 metres) that, with bole diameter and lean of some trees, represents a tall vehicle strike hazard.

If the street is to be rebuilt, which is clearly a pressing need, such work will have a further impact on the rooting systems on trees who's vigour is already suspect. There was a suggestion at the time of the 1981 report (at page 35) that the narrow road surface of 11 metres represented a very narrow travelled surface for four lanes and that continued transit use, coupled with another lane, lent weight to the need for eventual widening by reducing the centre median. While widening may or may not be justified, any tree-side roadway or curb rebuilding will significantly impact most trees.

An engineering consideration often forgotten but worthy of mention here in the context of replacement tree choice is the question of leaf retention in the fall (assuming deciduous trees). If tree leaf retention is pronounced, there is the possibility of a densely planted tree lawn retaining fall frosts on the roadway well after surrounding areas are unfrozen, causing an increased accident potential or increased road salting activity.



SCALE · 1:200 OR 1/16" = 1'

Typical Boulevard Cross-section

TRAFFIC PATTERN CONSIDERATIONS

As the university and the endowment lands have experienced growth, traffic usage has similarly grown.

Upgrading of the 16th Avenue to Blancha, Marine Drive from 16th to the edge of the endowment lands at 41st and some improvement on Chancellor from Acadia to Blancha have no doubt improved traffic flow in recent years on the campus periphery. However there has been no commensurate improvement of either Chancellor to Marine Drive (also a tree lined street with loss of the street tree resource) or of University Boulevard.

As the official community plan, housing growth, campus student, faculty and support staff or commensurate development dictate traffic pressures will increase.

Concern has been expressed by residents that present tree removal is a subtle subterfuge to allow for widening or rebuilding of University Boulevard.

The current thinking on traffic patterns in the future around the campus district and how that may or may not influence University Boulevard should be dealt with explicitly to the extent it is, or is not known by the Ministry of Transportation and Highways staff.

TROLLEY USE

Plans for trolley use on University Boulevard date back to the late 1970's and came to the fore in early 1980's. In 1981 Gardner Peepre and Associates completed a detailed analysis of each Silver Maple on the street with a view to integrating the trolley wires and suspension system into the then existing tree resource with minimal impact (10).

In 1988 Brian Fisher completed an updating of the 1980 report in order that B.C. Transit could actually implement the trolley line extension plan.

Trolley use of the Boulevard appears to be a continuing need into the foreseeable future. As such the safety needs of the 600 volt DC system and the trolley coaches themselves dictates that either existing tree maintenance or replacement tree species choice and placement must be reflective of the trolley system constraints detailed in the above two referenced reports.

PLANNING CONSIDERATIONS

The University area is experiencing some growth both on campus and in the surrounding endowment lands. Some of this growth includes the addition of housing units. Continued growth throughout the Lower Mainland is anticipated in all Greater Vancouver Regional District planning strategies and it can be envisaged that a small percentage of this will occur in and around the whole area west of Blancha.

It is understood that a Community Plan (OCP) process is underway for much of the area served by University Boulevard as well as Marine Drive, 16th Avenue, Chancellor Boulevard and associated roads. An Official Community Plan is a broad statement of policy guidelines for the future development of a specific area. Typically it consists of two components; a text articulating general policies and objectives, and a map illustrating the effect of the policies on locations within the plan area. The plan influences how land use will evolve and how it will be constrained or permitted through the use of zoning and sub-division.

As the plan is developed so too will be its implications, particularly for growth or lack of it. This in turn will influence traffic needs in the area and consequently the future of University Boulevard well into the 21st century.

THE TREE REMOVAL CONTINUUM

The Silver Maples are not accurately dated as to their planting date. Research by Gardner Peepre suggested 1928 by Professor Buck. The trees would have been between five and fifteen years old at establishment in the tree lawn. This would suggest an age in 1995 of about 80 years old possibly a little older. Confirmation of actual age will require a detailed ring count.

Given the general age range, the trees are certainly reaching their end of a useful life. See Elias (6) and Fowells (8).

Gardner Peepre suggested that full stocking would be about 280 trees at the same as existing spacing (at page 18). Fisher in his report (13) examined 213 trees. The north side as of August 18th shows 108 maples, some of which are marked for removal; the south side some 59 maples with almost none yet to be removed of the high hazard list most recently established by the Ministry of Transportation and Highways. Present maples standing count of this date is 167 trees. In addition there are presently 8 plane trees on the north side of the westerly end of the Boulevard and some 12 on the south side where the boulevard bends opposite the Chapel.

Assuming the street was fully planted at inception of the street beautification program, attrition has been from 280 down to 167 with a number of hazard trees remaining at the time of the cessation of work on Friday, August 18th. Some 44 old and new stumps are evident at their juncture.

Tree stocking is thus down to 61% and will drop further as remaining hazard trees on the north side are removed.

Thus tree removal of the proposed 50+ trees at this time is not a new need. Safety has so far dictated that almost half the trees have been taken down in the interest

of safety. This can be safely inferred since there are few other intrusions, other than the trolley system, into the existing plantings with the possible exception of the south side commercial at Parkway to Allison.

This rate of removal over time is not a surprise given the tree type, narrowness of the tree lawn, tree age, early tree care methods, soil type, present traffic in comparison with the 1920's and the lack of maintenance over recent decades.

EXISTING TREE CONDITION

Existing tree conditions are a direct reflection of the past. Evelyn, the originator of modern forestry and arboricultural practice, suggested that the informed and observant professional would read the history of a tree like an open book. (7)

The present Silver Maple have not had a happy past. In all likelihood, they were pollarded at one time. When funds no longer permitted this practice, a branching scaffold developed or was developed.

Concern over the trees on University Boulevard is not new. In the 1940's Muirhead (15) undertook a review of the street trees in the University area of Vancouver in his comments on University Boulevard he noted (at page 43 and page 44):

> *The Silver Maple is probably the worst possible type of tree for boulevard planting but none will deny its great beauty. It is brittle, easily damaged by wind and ice, and difficult to manage since it throws out long slender shoots which must be cut back, and which then will usually incur dangerous decay. Its root system vies with the Elm and Poplar in its persistence. It will extend up to several hundred feet, heaving pavements, clogging sewers and starving lawns in its wake.*
>
> *It is a most valuable tree for parks or city estates owing to its resistance to adverse conditions, but is under no circumstances a street tree. The writer predicts that if it is not removed, the cost of pruning, clearing drains and replacing sidewalks will rapidly double or treble the cost of removal.*

The edge of the road bordering the golf course could have related plantings to mark end points to each length of road. These could well be native, but if transitionary plantings were preferred clumps of Red, White and English oaks and Liriodendrons would be entirely suitable. All these trees do exceptionally well in this area. However encouragement of the native growth such as Douglas firs and alders in related strips and stands could easily be arranged cheaply and with great effect as has been done for the road through Stanley Park approaching the Lion's Gate Bridge.

The great variation in size of these Silver Maples is due to the extreme poverty of the soil especially in the cuts, and the dryness of these soils in summer, once more proving the maxim; - plant no trees without adequate preparation of the ground or where their cultural conditions cannot be met.

Despite the loud cries of protest when these trees were cut back a few years ago this was the only possible method with such long slender stems to combat. The fault in fact lay with the planter, not the pruner. As can be seen however, sprouts are several inches below the place there the cuts were made due to decay taking hold; this in time can be expected to extend down the tree. There is only one successful method of dealing with Silver Maples. That is never to plant them on streets.

Gardner and Peepre (10) in their extensive review of Silver Maples as part of the proposed extension of the trolley system onto the University Campus found that it was judged by a wide variety of authors to be a fast growing, short-lived tree, prone to suckering and structurally weak branching, crown collapse and fungi attack causing rapid decay (1,2,3,4,5,8,13,15,16,17,18,19,20 and 21). Pirone (12) noted that its use if now prohibited for street tree use in most cities.

In the Gardner Peepre Report (10) the then health of the trees (1981) was recognized as a concern:

Once the trolley system is in place, if it is approved, it is strongly recommended that there be a consistent program of ongoing maintenance to ensure the trees are maintained in reasonable health and free from deadwood which might fall and damage the trolley wires or other trolley system fixtures such as insulators or support arms.

The recommendations here are made in direct relation to the integration of the trolley system with the existing tree resource. If the various parties involved, including the University Endowment Lands, the Department of Highways, residents and all the utility users of the University Boulevard corridor can resolve the questions that arise from this study concerning the general health of the Silver Maple and the condition of the existing roadways, pathways, bikeways, curbs, water main, etc., it may be that the existing resource should be progressively replaced.

Tree health is discussed fully in Section 2.4.3. In that section it is concluded, from the factors reviewed, that many trees are not in very good health or state of repair. This situation is, in large part, due to original maintenance practice and in more recent years to the lack of a consistent maintenance program aimed specifically at improving individual tree health.

Many trees along the Boulevard are actually affecting the roadway or curbs through aggressive or surface root growth, while some trees are leaning significantly toward the roadways.

This report is not intended to be an exhaustive examination of the health of the Silver Maple; rather, the client requested that the consultants primarily examine the impact which the trolley extension proposal would have on the existing trees. However, it quickly became apparent that from an arboricultural standpoint some comment should be made regarding the health of these trees. While any substantial amount of restorative work is clearly beyond the scope and responsibility of those directly concerned with transportation to and from the University of British Columbia, there is some tree work that will be required and this may provide the impetus of the Endowment Lands administration to consider the status of the trees and future planning.

A number of brief recommendations follow concerning the health and future planning activities:

1. *Consideration should be given to crown thinning in most trees to reduce the excessive crowding within many crowns and for dead wood to be removed.*

2. *Trees with extensive trunk decay should be given careful internal analysis to determine the extent of such decay and unsound trees should be removed.*

3. *Trees with large branch cavities, where these remain on trees after the required pruning necessary to ensure the proposed trolley wire clearance, should be carefully examined to see if these branches*

have lost their structural strength. Those limbs which are unsound should be removed.

4. *The heavily leaning trees should be examined carefully by a competent Arborist to see if any are likely to blow down through root failure during adverse weather conditions.*

A number of trees are in reasonable structural condition yet are on the poor side when assessed for vigour. A program of tree fertilization may be considered to encourage better health and ensure extended longevity.

A number of trees are presently damaging the roadway, curbs and sidewalks. A decision will be required soon on the most appropriate course of action to remedy this situation. Some options will clearly affect tree health or retention. This problem should be addressed soon and incorporated in the long term planning decisions envisaged for University Boulevard, and for street trees within the right-of-way.

A number of gaps presently occur along the Boulevard. Using a spacing similar to that used in the past, only 77% of the potential street tree stocking is met with the existing trees. Thought must be given to the possibility of replanting these gaps and the choice of species that will be used.

The present tree resource, with the exceptions of those trees in poorest health, could be retained and somewhat enhanced by proper arboricultural practice. This would allow between 15 and 25 years more from some trees before rapid decline is likely. Notwithstanding this time horizon, it is recommended that some thought be given to preparing a plan for progressive replacement of the trees, starting first with those in poorest health or hazardous condition as well as with the present gaps in the existing planting.

If it is decided to construct the transit trolley system along University Boulevard, it will be essential to ensure that work is programmed and integrated with the schedule for the trolley system construction and stringing. Moreover, it will be necessary to ensure that regular maintenance over the long term, is sufficiently frequent to preclude, at least within reasonable expectations, any major tree failure that would damage the trolley system or be hazardous to those who use the Boulevard.

Fisher (12) in his study noted that lack of maintenance was a major concern and was urgently needed:

As the work proceeded, it became obvious that we were not dealing with a healthy well-maintained tree resource, but rather, 213 Silver Maples, many of which are in decline due to improper procedures of abuse in the distant past and general lack of care in the recent past. It is not my intent to be critical of anyone with this statement. Many of the problems which presently affect these trees date back 30 to 50 years. It is my intent, however, to state, in the strongest possible terms, that a regular tree maintenance programme must be implemented as soon as possible if these trees are to remain a viable resource for any reasonable length of time.

None of this work, despite major urgings, has been undertaken. This despite the major failure of the tree that impacted the transit bus (see Plates 2,3,4,5 and 6).

In the most recent examination of the trees in question, Consulting Arborists Linderbuk, and later Nicolson and McGregor have all endorsed the past findings. The team of McGregor and Nicolson have marked some 59 trees for immediate removal as hazard trees. The remaining trees are still at issue as the findings from this initial take is examined in detail and translated to the further examination of remaining trees.

THE ISSUE OF SAFETY AND DUTY OF CARE

There is a history of removal well established for the Boulevard. Safety has thus been an issue for many years. While twig and small branch drop has occurred throughout the life of the trees, a characteristic of Silver Maple, though an annoyance, it will not have been a problem in the early life of the trees.

More dramatic is the more mature growth and loss of major limbs that have lost structural integrity and broken away from the crown. Evidence of this is shown by larger, partially occluded tear wounds on some trees, though many of the worst examples have now been removed.

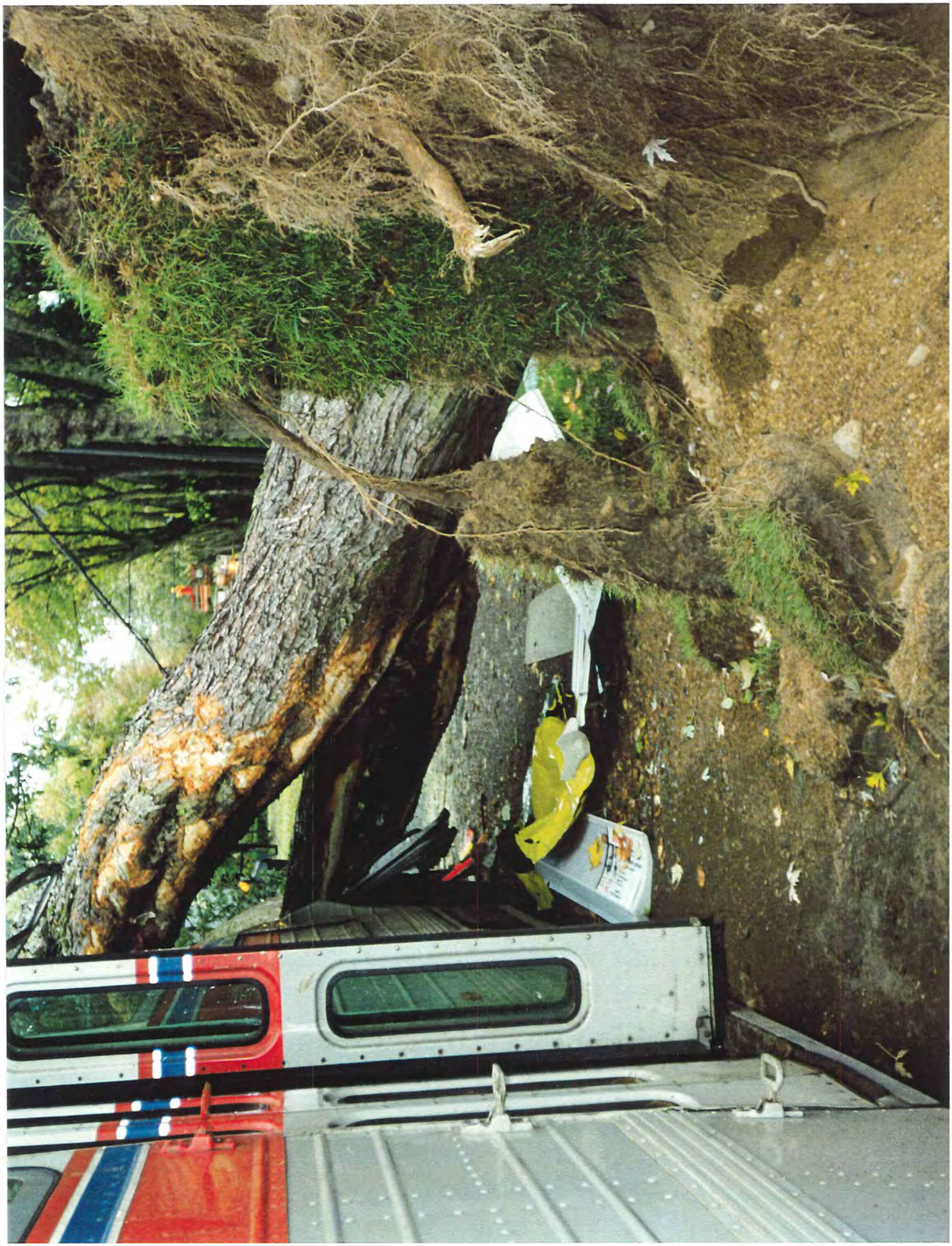
Equally dramatic is the blowdown potential of some trees. Weather conditions and root condition are not known at this juncture, but the bus damage shown in Plates 2 through 6 is a telling example of the ferocity a larger tree can bring to bear.

The chain of losses and the various consultants' reports over time provides an evidentiary backdrop to the duty of care issues. Public officials responsible for the roadway cannot, in good conscience, knowingly suffer major hazards to exist at the roadside.

While they themselves may not determine the risk presented in this case by the Silver Maple, they have a duty of care to the general public to ensure that knowledgeable arboricultural expertise is applied to the potential hazard. Without this, liability will attend and attach to the Crown, resulting in the potential for major public costs if the courts found for a plaintiff suffering from injury or death as a result of negligence in the performance of a duty of care where the hazard was pre-known and unattended by the Ministry.

DESIGN CONSIDERATIONS

The probable intent of Professor Buck in choosing Silver Maple for University Boulevard was, in all likelihood, to have a fast growing tree of larger structure providing a canopy effect over the paved and pedestrian portions of the right of way. To this end, his expectations were well met by the overall appearance and by some trees. The variability of growth exhibited by some individuals is due either to genetic variability of the probably wild collected stock or seed, or to lack of good tree pit preparation in the narrow tree lawn. It certainly appears as if uniformity of appearance of a vase shaped canopy was the initial desire. See Plates 7,8 and 9 for the boulevard layout and trees in 1981.




2934
010
"I JUST MELT OVER A WHOPPER."
HOW ABOUT YOU?
BURGER KING

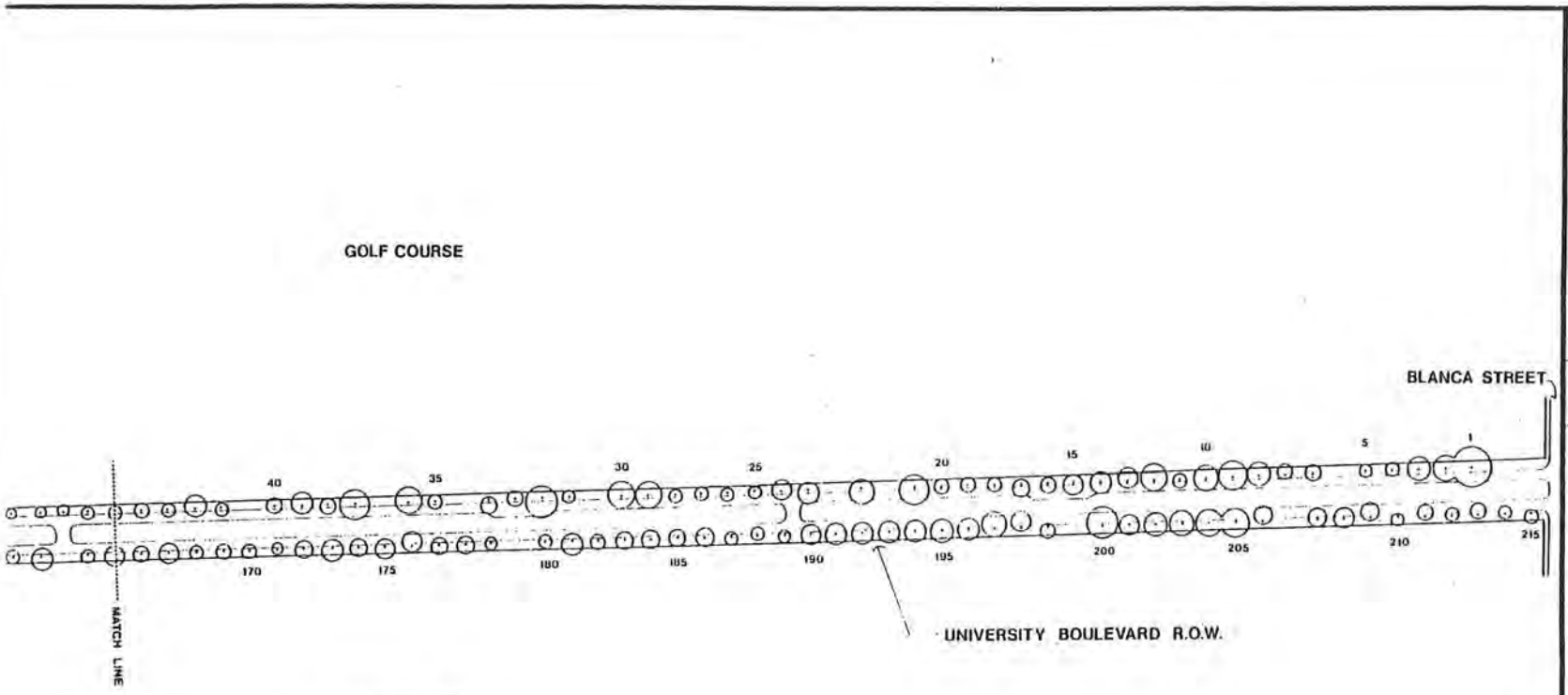
The centre boulevard has some smaller species of flowering tree, mainly cherry, but it is not known what the early view intent was, without more archival research. It now provides a fairly 'open' appearance and differs from some centre medians such as Boundary, which are more extensively planted to larger species.

A number of factors will determine the final replant design for University Boulevard particularly if extensive rebuilding of the roadway is envisaged. The tree lawn is narrow for large species and this is further complicated by the narrow paved lanes forcing transit trolley coaches close to any trees on the curb lane. Young, wide-spreading replacements with youthful height growth will grow into this lane, proving to be a vehicle hazard.

A potential solution is the choice of a tall growing, yet narrow crowned (fastigiate) tree selection.

Larger growing trees should be a focus in the replacement planting design in the opinion of this writer or the character of the Boulevard will change significantly even with the adjacent tall tree canopy in the golf course plantings. Scale, thus is important consideration. This plays into the need to establish fairly large calibre trees at the onset to allow for crown height and reduced vandalism.

Since it is the intent of the Ministry of Transport and Highways to convene a Panel to undertake final choice, this group will identify the design criteria to be utilized. However, an important consideration will be spacing distance. This, in turn, must reflect the constraints of the trolley support system. As narrow as 20 ft. and as wide as 50 ft. is practised on streets in Vancouver. This provides dramatic differences in appearance. If narrow crowned trees are chosen it may be possible to plant, both in front of and behind the pedestrian pathway, producing a double row on each side of the right of way.



LANDSCAPE STUDY

University Endowment Lands
Greater Vancouver Regional District

TREE INVENTORY

LEGEND

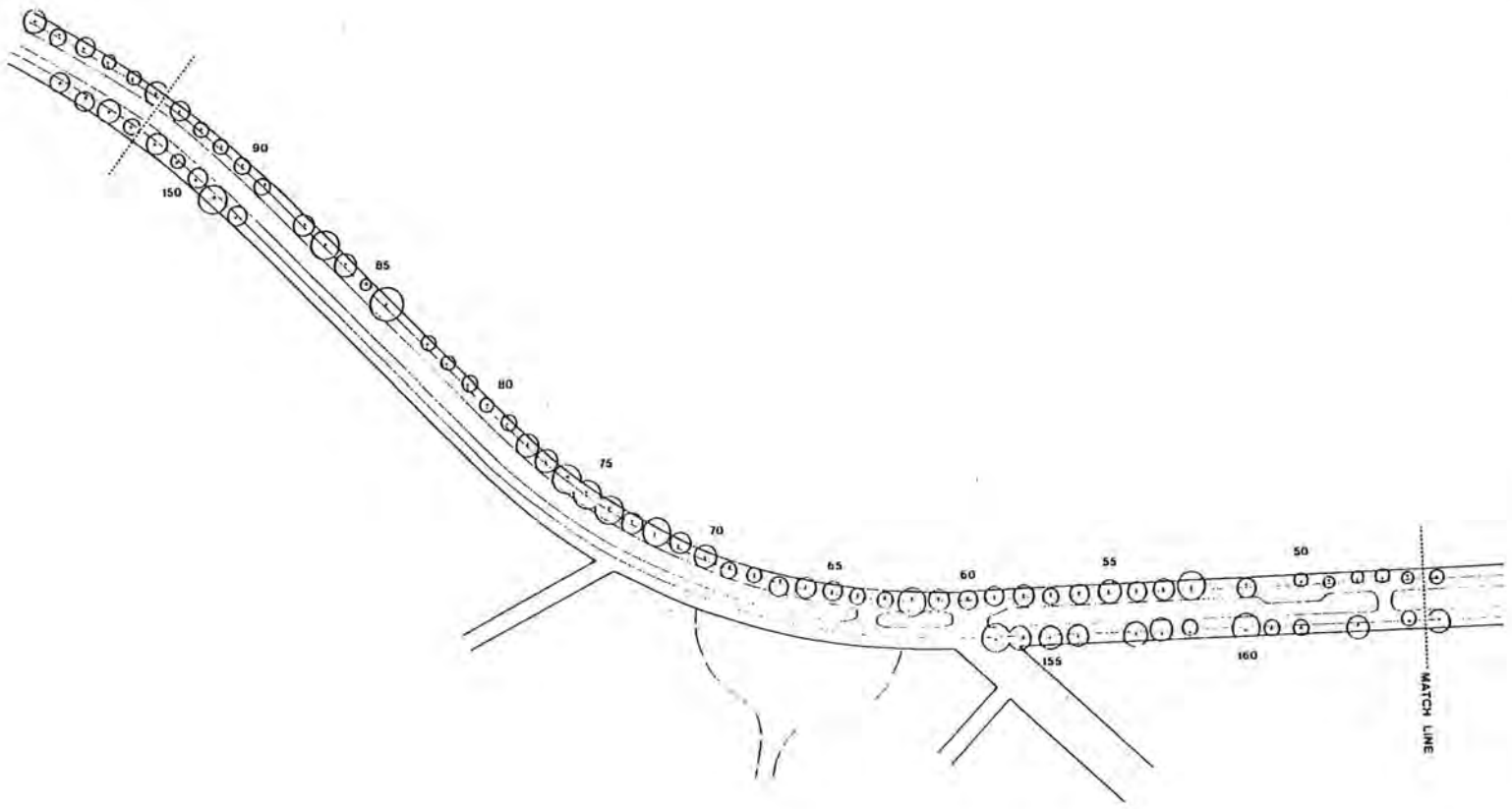
TREE LOCATION & CROWN SIZE

145 TREE NUMBER

SCALE

100' 300'
0 200' 400'

1



LANDSCAPE STUDY

University Endowment Lands

Greater Vancouver Regional District

TREE INVENTORY

LEGEND

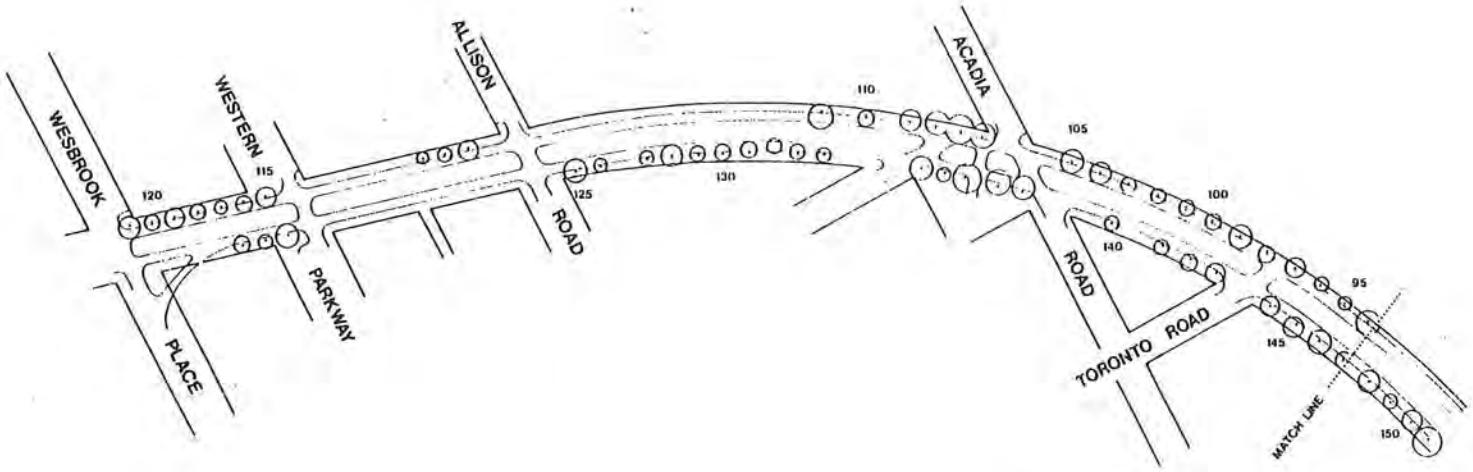
TREE LOCATION & CROWN SIZE

145 TREE NUMBER

SCALE

0 100' 200' 300' 400'

2



LANDSCAPE

STUDY

University Endowment Lands

Greater Vancouver Regional District

TREE INVENTORY

LEGEND

TREE LOCATION & CROWN SIZE

145 TREE NUMBER

SCALE

0 100' 200' 300' 400'

3

While the majority of the street is presently Silver Maple with a few London Planes having been introduced, it is possible to consider a variety of species. For example, a single species along the straight stretch from Blanca to University Chapel, then a change to, say, Acadia and then another species from there to Allison or to Westbrook.

The use of an alternating design theme such as that with hawthorn and plum or plum and cherry used on some residential streets in Vancouver is not likely to be appropriate.

With these general design concerns outlined, it remains for the final criteria to be developed as the roadway repair information becomes more readily available and the Panel meets.

TREE REPLACEMENT CRITERIA

The writer's data base consists of some eight hundred species, selections or cultivars of the predominant tree families used for ornamental planting in North America. The information was developed from a wide variety of references and nursery catalogues. It contains 20 fields of information.

- Plant name
- Plant height at maturity
- Crown spread
- Rate of growth
- Longevity or life span
- Form of crown or habit of growth
- Rooting habit
- Hardiness
- Soil characteristics preferred
- Light preference
- Shade tolerance
- Wind firmness
- Drought tolerance
- Flowers or special attributes
- Fruit
- Fall colour
- Container use

- Pests or special constraints
- Texture
- Mass

This data base was challenged with a number of tree selection criteria. These fall into 4 objective categories and the first yield is then tested against 3 subjective categories. There are no absolutes in this process. Other arboriculturists might utilize a similar or different method and might produce a different candidate list.

Category 1: Appearance

- Leaf size
- Leaf shape
- Leaf colour
- Plant texture
- Plant mass effect
- Crown form
- Crown spread
- Size at maturity

Category 2: Environment

- Soil requirements
- Moisture requirements
- Light preference
- Zone
- Pests
- Special constraints
- Air pollution and salt tolerance

Category 3: Special Attributes

- Leaf coloration
- Bark
- Buds
- Winter appearance
- Flowers
- Unique characteristics

Category 4: Maintenance

- Entomological
- Pathological
- Physical
- Roots
- Bark
- Leaves
- Staking
- Watering
- Pruning

Category 5: Design Considerations

- Design objective
- Tree lawn width
- Scale requirement
- Spacing
- Context of planting
- Plant shape
- Prior species or use

Category 6: Propagative Considerations

- Stem form (single or other)
- Method of propagation
- Nursery pruning practice
- Availability in the trade
- Uniformity of blocks for #'s required
- Typical transplant/sale root system
- Calliper in trade
- Stock origin if known
- Grower reputation
- Probable public acceptance

Category 7: Contextual Consideration

- Surrounding vegetation
- Surrounding land use
- formality
- History of use in Vancouver
- Expectations
- Budget considerations
- Planning time horizon

The data base review presents with a list of possible species and cultivars. This list is then refined down in the light of local knowledge. A tree profile workup is then usually done to narrow the field of choice.

In this instance the Ministry of Transportation and Highways have expressed a desire to undertake this latter stage and will be providing backgrounds on the stage 1 selections.

These selections are shown in Appendix I of this report.

In the case of this study photographs of each species have been made from locations in Vancouver, Richmond and Burnaby on Saturday, August 19 and Sunday, August 20 in largely sunny conditions. The list of photographs and locations is given in Appendix II. The photographs are attached as Appendix III.

TREE RETENTION OPTION

As discussed in the section on existing tree condition, a number of trees have been inspected in the field by a competent arborist and a number found to fall in the highest category of hazard by their ranking.

The tree work required to remove these hazard trees was stopped due to public protest, although most if not all on the south side of the boulevard have been removed to grade or to the central bole. Most of the marked hazard trees on the north side remain. Only those judged to be of immediate concern have so far been taken when work is completed. It should not be inferred from this that trees remaining are thus safe.

Some 59 maples remain on the south side without pruning or other remedial work at this time. A number will fall into the doubtful for retention category, particularly as the

extent of some limb decay is now evident as successive trees are removed. The south side still has 12 London planes.

The north side without removals has 108 maples and 8 London Plane. The condition of some trees after immediate hazard trees are removed will, in all probability, be suspect.

It does not seem viable to just stop all work with trees judged unsafe remaining in the highest category assigned by Dr. Shirley Nicolson.

The option of retaining the remaining stock will depend on the findings of careful inspection of the present takedown and possibly a more intensive survey with a bucket truck of any tree on the north or south side suggested for retention.

As suggested by Fisher (13) radical pruning, and some cabling, may well be required. Cabling of Silver Maples, a weak wooded species with poor mechanical strength is open to serious scrutiny by the profession. Risk reduction and cost effectiveness would be serious criteria to apply to this requirement.

Previous root failure of a major tree (see Plates 2-6) may also put all suggestion of upper crown work in question if there is a suspicion that root integrity has been lost due to past road, sidewalk or curb repair activity or root rots or a combination of both. Further investigation of whole tree failure predisposition is warranted and indicated.

Some 100 to 150 trees would appear to be candidates for initial retention. This is in contrast to full stocking of about 280 to 300 or greater depending on replacement species choice, spacing and road repair or realignment activity.

Silver Maple retention of any trees must be viewed in not only the light of recent findings and detailed tree by tree investigation but also a clear picture of future road work impact on tree health.

If roadwork impinges in any way on trees already suffering incipient decay, crown decline, loss of vigour or root injury, then this option is a doubtful expedient to mollify those concerned with the loss of this resource.

It embodies a level of technical deceit that suggests that the course of action is appropriate when, in fact, a more holistic, longer range view would yield a more aggressive removal strategy.

THE PARTIAL TREE REMOVAL OPTION

The trees marked and of concern to the consulting arborists, Nicolson and McGregor, were stratified into four categories by acculor assessment. This would indicate that category 4 - hazard trees and category 3 - trees of significant concern, should both be considered for replacement.

This would allow the final count of acceptable trees to be further thinned to a level where immediate and potential hazard trees are removed, remaining trees are the subject of intensive maintenance, and a more aggressive tree replacement program adopted.

Uniformity of appearance now and in the future would be within reach assuming a staged, final removal of the Silver Maple over time.

THE COMPLETE TREE REMOVAL OPTION

With the possibility that the final, *relatively* safe tree population for a fairly short time horizon may be only 100 or so trees, with a fair measure of risk remaining, or with vigour

declining for them because of collateral road work, an option is to remove all the Plane and Silver Maple, properly rebuild the street, allocate as appropriate proportioning to the travelled surfaces to accommodate projected use, whatever that is, and institute a well thought out replacement program.

The question of capital cost, other roadwork priorities in the Lower Mainland and planning horizons will dictate the acceptability of this option. Public concern, while very valid about tree retention, may, in fact, feel that the most viable public safety and public expenditure policy is to deal with the problem now in a comprehensive manner.

Street redesign will be contingent on projected use and traffic patterns. It will influence landscape design as the right-of-way is cross-sectionally subdivided into uses. This will, in turn, allow for a well articulated street use plan to be adopted for the midpoint of the 21st Century such as Professor Buck must have envisaged in 1928 for the end of this century when he undertook his work some sixty-seven years ago.

REPLACEMENT PLANTING SPECIES OPTIONS

There are now a number of trees missing and a number of stumps where trees did exist on the boulevard, even if the remaining marked hazard trees were now removed.

Tree replacement is thus warranted. Some might consider continuing on with the theme established by the existing 20 London Plane already planted on the street. This species was suggested for use around the Vancouver courthouse. An exhaustive study at the time (Gardner and Neill) (12) found that this species, while of grand scale and apparent ability to withstand urban conditions, nonetheless suffered from a number of detracting factors that were not viewed with favour by the staff of the Vancouver Parks Board. Principal amongst concerns was a propensity to exfoliate larger quantities of bark when mature, drop leaves almost all summer due to an endemic leaf anthracnose, produce prickly fruit in large quantities and to produce and lose large quantities of fine

leaf pubescence. Some people are extremely allergic to these leaf hairs and they prove a serious health hazard to asthma sufferers.

London Plane is not suggested as a suitable replacement species.

For this report the author interrogated an extensive database that has been utilized to identify suitable candidate tree selections. These have been cross referenced with the selection criteria developed for this report and the resulting choices are listed in Appendix I.

The design considerations will drive the final choice or choices. This report does not attempt to foretell the eventual design guidelines that will be adopted by the consultative panel. However, the pallet of trees chosen at this stage provides a rich enough spectrum for most envisaged demands.

A number of maple have been chosen. Some are narrow crowned (fastigiate) and a number are more broad in the crown. These would address use either on the narrow tree lawn or in the centre boulevard. Locational use will depend to some extent on initial size, availability and initial care in pruning. This concern applies to all selections. No red or 'fancy' leaved varieties of either norway or sycamore maple have been selected at this stage.

A hornbeam has been selected due to its urban durability. A chestnut free of blight problems is chosen as is a narrow crowned beech; a wider crowned beech could be planted in the centre median. Many majestic green and red leaved beeches are seen around Vancouver.

An unusual conifer of great antiquity, Genkgo biloba, with two constrained crown variants, is selected.

The stately, relatively pest free yet fast growing tulip tree is selected. Two small leaved yet interesting conifers, Dawn Redwood and Swamp Cypress are chosen.

A large body of oaks are grown in the nursery trade. Many would be appropriate for University Boulevard. A select list is presented here.

The list is completed with two limes used widely for street tree planting.

Whatever tree species and/or cultivars are chosen, availability in the trade at requisite size and in good condition and crown conformity will constrain final selection. When decided upon, no substitutions should be allowed. Trees should originate from similar nursery blocks and be of the same age. Careful specifications should be developed for the tendering documents and rigorous inspection and rejection of unsuitable plants should occur.

Suppliers intending importation from Oregon or Washington State should be able to guarantee that calliper size and rootball condition will meet or exceed BCNTA and Agriculture Canada requirements.

LONG TERM MANAGEMENT

Whatever the option adopted, it should not be based on benign neglect, the apparent approach for some past decades. Both streets and trees wear out. Their life expectancy can be prolonged by insightful, planned intervention.

The long term management plan should recognize the expectations of the various stakeholders, the Ministry of Transportation and Highways, B.C. Transit, the University Endowment Lands, the residents, the University administration and the various user groups who use the right-of-way and the various heritage groups who have an interest in public assets.

Public policy for the long term management of University Boulevard should be explicit not implicit. It should be written not spoken and it should be the subject of periodic review.

A heavily planted street with narrow tree lawns, new or old, requires a program of maintenance. A program of maintenance requires specifications and budgets. Work undertaken requires inspection and approval. This street is no ordinary street as seen by the public interest expressed in the present tactics of management. The Ministry of Transportation and Highways as lead stakeholder has the opportunity to show leadership in developing the street plan for the future of University Boulevard.

LONG TERM MAINTENANCE

Whatever option chosen, trees will be a landscape element on the street. No tree is without needs in any phase of its life.

Tree needs may be met aggressively or passively, well or poorly, early or late.

Done with care, concern and consistency the University Boulevard street tree maintenance program will ensure safety, efficiency, long term tree health. In turn this will maximize the design objectives set for planting in the first instance.

The accumulated knowledge that ensures replacement tree choices that start at the benchmark of appropriate species will be leveraged into the future if matched with a level of landscape maintenance that reflects the high standards that a unique entry road to the University Endowment Lands and University Campus demands.

CONCLUSIONS

1. Silver Maple (Acer Saccharinum) is a fast growing but weak wooded member of the maple family. It is not now used as a street tree because of concern over mechanical failure. This is borne out by the many authors that have recorded the undesirable features of the species when used as a street tree.

2 At the time it was chosen in the mid 1920's these undesirable characteristics may not have been evident.

3. The tree may have been chosen with no expectation that it would be allowed to develop a full scaffold crown. It may well have been envisaged that it was to be subject to annual pollard pruning.

4. The original stocking of the street, if fully planted, would have been close to 300 trees.

5. The present number of trees, 167, brings stocking down to around the 60% at present and down close to 50% if those remaining identified hazard trees are removed.

6. The removal of hazard trees is not a new departure. Trees have been removed for safety reasons over a number of years. Old stumps remain as a testament to previous trees of concern.

7. Tree maintenance over the past few years has been minimal.

8. A number of reports have recognized the need for ongoing crown maintenance and its fundamental importance to any prolonged life of the existing resource. Such specified maintenance has not been undertaken in recent years.

9. The present trees are exhibiting decline, long branching, weak crotches, bark inclusion, poor mechanical attachment, large branch failure, stem and branch cavities and decay in varying degrees. Some trees have been marked by a consulting arborist team retained by the Ministry of Highways and Transportation as trees in a hazardous condition.

10. The Ministry had initiated a program of hazard free removal. This was to be coupled with a tree replacement program with input from the general public.

11. The tree removal activity became an issue when both the need for tree removal and the possibility that it was a precursor to other road work such as street widening was questioned by members of the general public. The concern was increased by media interest and complicated by an apparent disparity of agreement on the need for the removal.

12. Tree removal was based on safety considerations predicated on upper crown collapse and weak crotches with recent instances as the stimulus. It was not based on minor internal decay in larger trunks.

13. In recent times, certainly since 1990, there has been a number of significant failures, one of a whole tree onto a transit bus and a number of very large limbs detaching.

14. Trolley use of the boulevard requires that there be an ongoing maintenance program for either existing or replanted trees to minimize hazard to the trolley electrical system or the trolley buses travelling in the curb lane.

15. There are a number of utilities in the tree lawn and their condition, repair or replacement will influence tree health.

16. The University campus and the endowment lands are experiencing some growth. An official Community Plan that will direct such growth in the future is in its initial stages of development.

17. Growth in the area served by University Boulevard will influence any road rebuilding or realignment of the right-of-way.

18. The present tree lawn is narrow for larger growing trees. Little tree planting is present on the centre median. If lawn widening is envisaged, this would occur in the centre median.

19. No final decision has been made by the Ministry of Transportation or Highways concerning road upgrading.

20. The present road surface and curbs are in poor condition.

21. Any substantial rebuilding will have an impact on the health of any of the stock of Silver Maples that remain after hazard tree removal.

22. The work to remove hazard trees has stopped although almost all on the south side marked for removal have been or are in the process of being taken down. Hazard trees marked by the consultants remain on the north side.

23. A suggestion has been made that radical remedial work including cavity treatment, cabling, and major branch shortening, will result in a longer lifespan and retention of remaining trees. The limited tree scaffold, propensity for weakly attached sucker growth and inherent danger if cabling and bracing a weak wooded species do not support the application of these techniques on a wide basis on these trees which have received little care in recent years.

24. The evidence from trees already removed is of weak crotches, included bark, stem decay that has little vertical compartmentalization and reaching up into scaffold limbs. Coupled with lack of vigour in some trees the general condition of the total tree stock is suspect.

25. Hazard trees did and do exist on the boulevard. While some discourse may ensue as to what constitutes a 'hazard' tree, the duty of public officials is to retain competent expertise and to act on the advice rendered to ensure public safety.

26. The loss of a major tree due to complete windblown may suggest loss of root integrity due to root rot. This possibility must be fully examined if only Silver Maples are to remain.

27. Four major issues can be attributed to the present situation. The obvious emotional issue is underpinned by a general attachment to trees by many living in urban environments and the significant aesthetic contribution that the trees make to the boulevard at present. The technical issue of judging the arboricultural necessity for tree removal and the risk associated with tree retention is paramount in making informed decisions on the future of the trees. Such decisions must be coupled with and not isolated from engineering considerations on future road use, repair or rebuilding. The ethical issue of keeping trees of known propensity for failure after individual tree examination and assignment of a hazard ranking is one that applies to Ministry officials making judgments on behalf of the public while the same standard of responsibility does not extend to these critical of tree removal. The issues of long term management including tree removal, tree replacement and tree maintenance are important from a future planning and budgeting perspective. Urban streets demand an intensive level of the care by comparison with other roadways.

28. A number of strategic options apply. These range from complete removal of all existing trees at their this time coupled with street rebuilding and street tree replanting, through to a "do nothing for now" approach. Between these two polar positions are a number of viable alternatives.

29. An important consideration is to apply the recent knowledge from takedowns to furnish stringent criteria for any trees proposed for retention from this point forward if the removal and replacement of all Silver Maple is not deemed possible at this time.

30. Tree replacement has always been an integral part of the Ministry of Transportation and Highways approach although no final spectrum of species or single species has been chosen. Design considerations in conjunction with arboricultural, horticultural and engineering concerns will all play a part in guiding the development of the University Boulevard of the 21st century.

RECOMMENDATIONS

1. The expert Panel, once convened by the Ministry, should hear input from public representatives and then assist the Ministry and its consulting arborists with the final criteria for tree retention, if any trees are thought safe to remain.

2. The trees noted as hazard trees by the consulting arborists for the Ministry of Transportation and Highways should be reconfirmed as hazard trees and where confirmed removed without delay.

3. The Ministry should seriously consider the removal of all trees on the boulevard edge tree lawns at this time and couple street repair and rebuilding with a complete replanting program properly engineered on an appropriate design framework.

4. If all trees are not to be removed, the information gathered from present tree takedown should be vigorously applied to any trees intended for retention.

5. Any tree suggested for retention should be very carefully examined preferably from an aerial bucket device and any suspect tree removed in the interest of safety.

6. All factors including street repair, street rebuilding, stump removal requirements, replanting pit excavations needs, utility condition and transit system safety should be factored into tree retention decisions along with the strict arboricultural criteria already discussed.

7. No tree should be selected for retention based on radical stub cut pruning, cabling or cavity repair being utilized to ensure safety since such activity has a high risk potential in most individuals of Silver Maple on University Boulevard.

8. The question of possible root rot and whole tree failure, similar to the tree which hit the transit bus in 1991, must be resolved.

9. Tree replacement should be the subject of careful design that encompasses future street use, repair, rebuilding or realignment, tree choices that reflects tree lawn width, crown scale, shape and safety, horticultural considerations of site suitability, quality of stock, availability and site preparation needs as well as maintenance concerns and expectations in the future.

10. Neither the trees chosen for replacement nor any trees that remain after all hazard trees are removed will exist safely without a long term maintenance program. In the case of new trees this will include watering, fertilizing, pruning for crown shape, staking, tic removal, etc. This should be contracted based on explicit specifications, vigorously inspected and enforced. In the case of any Silver Maple remaining, they will require ongoing crown balancing, maintenance, deadwood removal, and inspection for potential failure. This will progressively reach a point where they move into the hazard category. Removal will then be required. This ongoing requirement must be recognized and coupled to replacement. Appropriate budgeting should be undertaking from annual work on this heavily used urban street.

REFERENCES

1. Baumgardt, J.P. 1968. How to Prune Almost Everything. New York: William Morrow and Co. Inc.

2. Bean, W.J. 1976. Trees and Shrubs Hardy in the British Isles. Vol. I. London: John Murray.

3. Carpenter, Philip L., Walker, Theodore D., and Lanphear, Frederick D. 1975. San Francisco: W.H. Freeman & Co.

4. Collingwood, G.H. and Brush, Warren D. 1949. Knowing Your Trees. Washington, D.C.: The American Forestry Association.

5. Dirr, Michael A. 1978. Photographic Manual of Woody Landscape Plants. Champaign, Ill.: Stipes Publishing Company.

6. Elias, Thomas S. 1980. The Complete Trees of North America. New York: Van Nostrand Reinhold Company.

7. Evelyn, J. 1776. Silva or a Discourse of Forest Trees. Published by the author.

8. Fowells, H.A. 1965. Silvics of Forest Trees of the U.S. Washington, D.C.: U.S. Dept. of Agriculture, Forest Service. Agriculture Handbook No. 271.

9. Gardner, M.R. 1993. Managing the Urban Forest in the Lower Mainland of British Columbia. Masters of Applied Science in Natural Resources Management Thesis. Simon Fraser University, Burnaby, British Columbia.

10. Gardner, M.R. and Peepre. 1981. Landscape Resource Integration. Proposed Trolley Extension. A Report to the Great Vancouver Regional District Transit Planning Group, Vancouver, British Columbia.

11. Gardner, M.R. 1980. The City of Vancouver Boulevard Tree Program; History, Analysis and Recommendations for Management. Vol. I. Board of Parks & Recreation, Vancouver, British Columbia.

12. Gardner & Neill. 1979. Choice of Species for Plantings Surrounding the Vancouver Courthouse. A Report Submitted to the City of Vancouver, Department of Engineering, Vancouver, British Columbia.

13. Fisher, B. 1988. University Boulevard - UBC Tree Management Strategy - Tree Maintenance Program and Restocking Recommendations. A Report to B.C. Transit Authority, Vancouver, British Columbia.

14. Hepting, George H. 1971. Diseases of Forest & Shade Trees of the United States. U.S. Dept. of Agriculture, Forest Service. Agriculture Handbook Number 386.

15. Muirhead, D. 1946. The Street Trees in the University Area of Vancouver, British Columbia. A Report to the University Lands with Recommendations for Future Planting.

16. Pack, Charles L. 1923. Trees as Good Citizens. Washington, D.C.: The American Tree Association.

17. Phillips, Roger. 1978. Trees of North America and Europe. London: Pan Books Ltd.

18. Pirone, P.O. 1970. Diseases and Pests of Ornamental Plants. 4th edition New York: The Ronald Press Company.

19. Rothenbeerger, Ray. 1977. A Look at Fast-growing Shade Trees. J. Arboriculture 3 (2): 40.

20. Sargent, Charles S. 1965. Manual of the Trees of North America. Vol. II. New York: Dover Publications, Inc.

21. Smith, Alice Upham. 1969. Trees in a Winter Landscape. New York: Holt, Rinehart & Winston.

22. Solotaroff, William. 1911. Shade Trees in Towns and Cities. New York: John Wiley & Sons.

LIST OF PLATES

APPENDIX I

CANDIDATE REPLACEMENTS

RECOMMENDED CANDIDATE REPLACEMENTS
FAMILY SPECIES AND CULTIVAR (IF APPLICABLE)

Family	Species	Cultivar	Comments
Acer (Red Maple)	rubrum	'Scanlon' 'Bowhall' 'Scarlet Sentinel' 'Armsrong'	highly recommended highly recommended
Acer (Norway Maple)	platanoides	'Parkway' 'Columnare' 'Emerald Queen'	highly recommended highly recommended
Acer	cappadocicum	species or 'Aureum'	 highly recommended
Acer (Sugar Maple)	saccharum	'Temple's Upright'	sugar maple has not grown that well on the west coast
Carpinus (Hornbeam)	betulus	"Fastigiata'	very hardy even in high traffic areas
Cercidiphyllum	japonicum		already on MOTH list
Castanea (Chinese Chestnut)	mollissima	sp.	
Fagus	sylvatica	'Dawyck'	some leaf pest problems
Ginkgo	biloba	species male or 'Fastigiata' 'Tremonia'	an unusual tree but significant
Lircodendron (Tulip Tree)	tulipifera	species or 'Pyramidale'	highly recommended
Liquidambar	styraciflua		already on MOTH list

Family	Species	Cultivar	Comments
Metasequoia (Dawn Redwood)	glyptostroboides		a deciduous conifer
Quercus robur (Cypress Oak)	fastigiata		some leaf problems in Vancouver
Quercus	coccinea	sp.	highly recommended
Quercus	palustris	sp.	
Quercus	petraea	'Columna"	needs upright form
Quercus	accutissima	sp.	highly recommended
Quercus	canariensis	sp.	
Quercus	phellos	sp.	
Taxodium	distichum	sp.	a deciduous conifer
Tilia	cordata	'Greenspire' 'Glenleven'	highly recommended
Tilia	x euchlora	sp.	

APPENDIX II

TREE PHOTOS BY LOCATION

UNIVERSITY BOULEVARD TREE REPLACEMENT
LIST PHOTOGRAPHS

Tree	Location	Ht.	Cal.	Space	Age	Hill.Pg.
LIQUIDAMBAR styraciflua	Shaughnessy/71st	40'	16"	30'	30?	p.243
(Hornbeam) CARPINUS betulus 'Fastigiata'	71st/Fremin (multi-stemmed at 3')	30			15-20	p.98
(Beech) FAGUS sylvatica 'Fastigiata' or 'Dawyck'	72nd/Selkirk	40'	12"	40'	30	P.178
(Norway Maple) ACER	Adera & 43rd	60'	36"	30'	50	p.46
ACER cappadocicum	Broughton/Barclay	60'	26"	40'	50?	p.40
ACER rubrum 'Scanlon' Red Sunset	Harwood/Bute	50-60'	12"	50'		p.48
(Tulip) LIRIODENDRON tulipifera	Nelson/Bute	40'		40'	35	p.243
ACER	Kingsway			20'		p. not there
(Hornbeam) CARPINUS betulus	Victoria/1st	35'		30'		p.98
(English Oak) QUERCUS robus	1st/Cassier					p.352
ACER rubrum 'Columnare'	"Bridges" Boundary			25'		p.48

Tree	Location	Ht.	Cal.	Space	Age	Hill.Pg.
ACER rubrum 'Columnare'	"Bridges" Boundary			25'		p.48
(Pin Oak) QUERCUS palustris	Lansdowne					p.351
(Scarlet Oak) QUERCUS coccinea	Lansdowne					p.347
CERCIDIPHYLLUM japonicum	VanDeuson					p.107
GINKGO biloba	948 20th					p.603
TAXODIUM distichum	Alexandra & Angus					p.642
TILIA cordata	Alexandra & Angus					p.503
TILIA euchlora	Costco					p.503

OTHER PHOTOS

- Species change - old Birch to Liquidamber - Angus & 40th
- Plane trees - Angus & 38th
- Stub cutting and sucker growth - Alexandra & Angus
- Boundary/Spruce - Centre planting
- King Edward Margarete - Centre planting

APPENDIX III

TREE PHOTOGRAPHS

A view of University Boulevard from the east and showing trolley and van on the narrow roadway. A protest sign regarding tree removal is seen in the foreground.

Stem wounds and carpenter ant activity has significantly reduced the heartwood and live stem wood of this tree following lower bole wounding some years ago.

Bark inclusion has occurred in a number of limbs which significantly reduces the mechanical strength and attachment of some branches.

This part of the tree trunk, how lying on its side, was the original attachment point of a large limb. The dark right side is an area of included bark with no mechanical strength decreasing the attachment of the associated large branch. This branch recently broke off falling across the pedestrian pathway narrowly missing the adjacent traffic light control system.

Internal decay of the stem part of the tree on the left will not in of itself contribute directly to the tree failure. The cleft and bark inclusion to the right of centre is a more arboriculturally significant indication of a potential failure point.

Very considerable strain is put on crotches by ever elongating scaffold branches leaning out over the roadway. Few viable pruning points exist to reduce the weight on this limb by drop crotch pruning.

Stub cutting limbs like this, with no alternative growth directional branches, will stimulate a frill of undesirable and very poorly attached but aggressively growing suckers.

Damaged curb edges and broken root ends support the contention that road reconstruction will have negative impacts on any trees suggested for retention.

This tree close to Westbrook shows the symptoms of diminishing vigour. Many smaller branch ends are devoid of leaves and are dying back.

This London plane, the other species that has been planted on the Boulevard, is showing signs of being unthrifty.

Larger pruning wounds, while not always the source of active decay, are nonetheless a place of organism entry as seen by the fructification growing on this recent, treated wound face where a large branch was removed within the last five or six years.

A view of University Boulevard from the south side looking east along the sidewalk showing the tree lawn, vase shape of the Silver Maple and typical trolley wire support poles.

Pedestrian, jogger, and cyclist use of the edge and centre median components of the right-of-way in addition of the four blacktop lanes.

Old pruning wounds are the entry point for decay organisms. The larger the wound the more extensive the entry surface and subsequent decay column.

Large, partially occluded wounds almost hide entry points for decay wherever branch break or pruning occurred in the past.

Large tear wounds like this are found on some trees. Large scaffold limbs with weak crotches allowed this large branch once attached here to fall as a jagged spear of considerable weight onto the pedestrian pathway.

Sap stain and incipient decay is seen in most of the Silver Maple. The effect of this internal activity of tree vigour, if any, is not known. Lateral spread of this activity is weakly resisted by Silver Maple. Vertical compartmentalization is minimal.

This old stump is still alive below grade. The roots are supplying sustenance to live tissue which in turn is supplying auxin levels that stimulate dormant buds. These show as sucker growth. Hard pruning of large limbs would stimulate similar poorly attached growth.

Some limbs of significant diameter show decay rifts and internal loss of structure that they present a hazard of failure under the strain of any adverse weather conditions.

Acer rubrum, Red Maple 'Scanlon' a columnar growth habit, good height and spectacular fall colour.

Acer rubrum 'Armstrong' slightly more open than the equally desirable 'Scarlet Sentinel'.

The appearance of a fastigiate Red Maple planted in a single line at a 20 ft. (6 metre) spacing.

Red Maple, probably 'Red Sunset' planted in the centre median of Boundary.

Norway Maple (Acer platanoides) as a mature tree providing a canopied appearance, probably after initial pollarding and later scaffold development. This much sturdier species shows little of the damaging decay and weak crotches of the Silver Maple it resembles somewhat.

Acer cappadocicum providing a street canopy in the west end of Vancouver. These trees appear to also have been pollarded early in life with their upright branching emanating from old knuckles. The trees are generally free from decay and have strong lower limb crotches.

Cercidiphyllum japonicum can be a broad spreading crown. This attractive, relatively pest free tree is grown on both single and multiple stems. Street tree use on a narrow tree lawn dictates a single stem selection.

Cercidiphyllum foliage is small and heartshaped, light green in summer, turning to a butter yellow in the fall. It is ultimately not as large as some of the other selections listed in this report.

Hornbeam, Carpinus betulus on a single stem but pruned up too high because off the narrow tree lawn in order to allow curbside traffic to pass without causing 'vehicle pruning'.

Castanea mollissima, the Chinese Chestnut, which producing fruit that might be a problem, it is also a majestic tree apparently free of major pests and diseases in Vancouver.

Chinese chestnut foliage is attractive. Fruit production, while much less than horse chestnut, may be a constraint for multiple tree use.

Fagus sylvatica, common beech, comes in a wide variety of leaf colours, leaf shapes and growth habits. This narrow form "Dawyck' is suitable for narrow tree lawns.

Beech foliage is often subject to insect and sooty fungal growth which can mar its appearance if not controlled.

This unusual deciduous tree, Ginkgo biloba, can produce a pyramidal habit on a tall growing stem providing scale and unique appearance.

Ginkgo furrowed bark is resistant to abrasion.

Liquidambar styraciflua has a distinctive appearance and sharply pyramidal form as well as spectacular fall colour.

This Liquidambar fall foliage colour is just appearing in August. Trees with aggressive growth due to heavy and prolonged rain in spring may suffer snowload branch break the following winter if wet snows are early.

Liquidambar has a tough, durable bark with attractive, shallow clefting and ridging when mature except on branches where it can be quite pronounced.

The tulip tree, Lircodendron tulipifera, is largely pest free, roundly pyramidal and upright in mature growth. Suggested by Muirhead in 1946.

Dawn Redwood, Metasequoia glyptostroboides, has a fine delicate lacelike foliage which drops in the fall unlike most coniferous species.

The Dawn Redwood marks an unusual but desirable street tree. Though not widely used, it appears pest and disease free. Wide buttressing in later life may require a fairly wide tree lawn.

The English or Cypress Oak, Quercus robus, comes in a variety of crown shapes. This selection "fastigiata' grows with a narrow upright crown.

Cypress Oak foliage becomes disfigured later in the summer which can detract somewhat from its close up appearance.

This row of Pin Oak, Quercus palustris, shows the effective avenue edge that can be created with this tree despite its tendency to have drooping branches in early years. An upright branching Pin Oak for streets is available.

Pin Oak foliage stays glossy green and attractive all summer long making this oak an attractive selection.

Scarlet Oak, Quercus coccinea, grows very well, with clean foliage and spectacular fall colour.

The foliage of Quercus accutissima is unlike that of other oaks. It is an attractive, large growing tree with few problems.

Taxodium distichum, the Swamp Cypress, would not be an obvious street tree chosen, however this fine leaved upright tree is worthy of consideration.

The Cypress has a tough, fine textured bark with reddish tones.

Tilia x euchlora, the Caucasian lime, has been used with success as a street tree in the lower mainland.

Caucasian lime foliage is generally free of major pests although some leaf eating caterpillar infestations have occurred in Vancouver. Early browning of inner grown leaves is seen in some locations.

Tilia cordata, the small leaved lime, has a number of selections that give distinctive pyramidal shapes.

The foliage of all limes is similar with a heart shaped pointed leaf.

London plane, Platanus acerifolia, produces many problems as it grows bigger including substantial quantities of exfoliated bark platelets.