CITY OF **VANCOUVER**

ADMINISTRATIVE REPORT

Report Date:	March 8, 2007
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TO: Standing Committee on City Services and Budgets

FROM: General Manager of Engineering Services
in consultation with the City Arborist

SUBJECT: West Broadway Sidewalk Rehabilitation and Street Trees

RECOMMENDATION

THAT this report be received for information.

GENERAL MANAGER'S COMMENTS

The issue of tree loss as part of the West Broadway sidewalk rehabilitation project has been the subject of a concerted letter/email writing campaign to the City over the past few weeks in anticipation of this Council report. Many of the letters that have been received do not appear to be based on a full understanding of what is proposed. Every effort is being made to save as many trees as possible on this street. The October 2006 report to Council estimated that two thirds of the trees could be saved. Based on the further work that has been done since, staff now estimate that 80% of the existing trees can be saved. However, it is not possible to address the serious problems with the existing sidewalks without removing some trees.

City staff in Engineering and Parks have done everything possible to minimize the loss of trees as a result of this project. The problems with the sidewalks on West Broadway are extreme. The direct cause of these problems is the aggressive root growth of the existing Linden trees. The root heaves in some of the worst cases have lifted the sidewalks as much as five to six inches higher than the doorways of the adjacent commercial buildings. It is not possible to rebuild a new sidewalk to match the existing buildings and the curbs along the street without removing these roots and, in the opinion of the City Arborist, removal of these roots will compromise some trees to the point where they will not survive or will not be stable.

Design solutions such as permeable pavements, structural soils, or root barriers (which will be used for all replacement trees) are not applicable to these existing problem locations and there is no choice but to remove the trees in the worst cases.

None the less, Parks and Engineering staff are now estimating that 80% of the trees can be saved through the various innovative techniques that are being recommended.

There are no additional funding recommendations in this report because there are no significant changes recommended in the scope of the project. Therefore the report is only for Council's information regarding that further work that has been done and the project will proceed under the previous approval unless Council instructs otherwise.

The only other choice would be to reduce the scope of the project and to leave portions of the existing paver sidewalk in place. The result of this choice would be a patchwork of areas with the worst root heaves periodically patched with asphalt. There would also be considerable ongoing hazards remaining in these areas due to the uneven surface and ponding water. This approach is not recommended.

CITY MANAGER'S COMMENTS

The City Manager recommends acceptance of this report.

COUNCIL POLICY

On October 19, 2006, Council approved the recommendations in report "West Broadway Street Rehabilitation and Transportation Improvements" which provided for a major rehabilitation of West Broadway, including the installation of pedestrian and bus bulges, the reconstruction of sidewalks with standard finishes, and repaving of the roadway. Approximately two-thirds of the existing trees between Larch and Waterloo would be retained, and 1050 square meters of planted areas would be installed. As part of the approval, Council requested:

> THAT staff to report back as soon as possible with options and budgets for sidewalk treatments which:
>
> - Retain a high number of existing trees through creative design;
> - Increase permeability of sidewalks and/or utility strips;
> - Allow for future installation and maintenance of large trees;
>
> These options may include pavers, tree trenches and /or structural soil;
>
> FURTHER THAT staff replace those trees that are absolutely required to be removed with specimens that will match the existing Linden canopy.

SUMMARY

The West Broadway Street Rehabilitation and Transportation Improvements report, approved by Council on October 19, 2006, estimated that approximately two thirds of the trees

between Waterloo and Larch were expected to be retained while allowing for the re-establishment of a safe and accessible pedestrian environment. The City Arborist has completed a further review of the West Broadway trees and, based on detailed radar scanning of the existing roots systems, now anticipates that approximately 20 additional trees can be retained which brings the overall retention number to 204 out of 249 trees between Alma and Larch. In addition, locations for approximately 10 new trees have also been confirmed.

Engineering staff have confirmed that further increases to the permeability of the sidewalks and/or utility strip are not feasible due to the low permeability of the local soils and the associate risk of flooding. However, increased permeability of the streetscape has been achieved through 1200 square meters of new landscaping and three infiltration catch basins.

Maintenance of larger trees will be accommodated through the use of larger tree pit openings which will provide additional space for root growth and will also help prevent sidewalk heaving over the near term. Pavers, tree trenches, or structural soil are considered too disruptive to the existing tree root systems.

For those trees that are absolutely required to be removed, the City Arborist recommends that a cultivar of the Persian Ironwood is the most suitable replacement tree for this area as it will complement the size, form and foliage of the existing linden, are pest free, and would be better suited to minimize future sidewalk impacts given the local conditions over the following decades. The new tree pits will use special soils and root barriers to reduce further root conflicts on West Broadway.

Staff are seeing ongoing risk management claims arising out of sidewalk heaving from boulevard tree plantings and escalating complaints of standing water from rainfall. There remain a number of root conflicts which must be dealt to re-establish a safe sidewalk.

PURPOSE

This report outlines the further review of options and budgets for sidewalk treatments on West Broadway which retain a high number of existing trees, increase permeability of sidewalk surfaces, and allow for future installation and maintenance of large trees.

BACKGROUND

Council approved the rehabilitation of West Broadway between Alma and Larch on October 19, 2006. The project includes paving, re-establishing a safe sidewalk, and the installation of bus and pedestrian bulges at a total estimated cost of $3,650,000. Work on the project started in January with the coordinated replacement programs for water and sewer infrastructure. While the water, sewer, and pavement infrastructure are at the end of their service life, the sidewalks have seen accelerated deterioration from heaving caused by the growth of tree roots and the native soil conditions in the area.

Public consultation on this project, as outlined in the previous report, has shown a strong desire by all stakeholders to retain as many trees as possible as they form a key characteristic of this area of West Broadway. Therefore particular attention has been dedicated to retain as many trees as possible while also maintaining the goals to re-establish a safe and accessible

walking environment for the public and to attain a better life cycle of the City's sidewalk infrastructure.

This report pulls together the expertise of City staff in Parks, Engineering, and Risk Management, and input of the West Broadway Business Committee, residents' associations, and concerned citizens, to outline additional options and costs to promote trees. Comments were invited from interested parties and the local business association and have been attached in the appendices of this report.

DISCUSSION

The review of options and budgets for sidewalk treatments have been guided by soil permeability studies, observations of recent sewer and water construction on West Broadway, City policies in relation to trees and sidewalks uses, and risk management concerns in relation to trip hazards in public spaces.

Tree Retention

The arborist has completed ground penetrating radar analysis of each tree which allowed for a detailed view of the existing tree roots. These scans have confirmed 20 additional trees that can likely be retained once root trimming or root shaving has been undertaken to re-establish a flatter surface around the tree. The Arborist will assess all trees after root trimming to ensure that they are safe and sound. Overall, it is anticipated that approximately 204 out of the existing 249 trees will successfully be retained.

Tree retention has been further enhanced by expanding the size of the tree opening from 1.2m x 1.2m (4ft x 4ft) to up to 1.8m x 2.4m (6ft x 8ft). This avoids construction closest to the tree where the roots are typically most heaved and minimizes the amount of root shaving required. In addition it allows more rainwater to infiltrate around the tree.
The opportunities for enlarging the tree pits are limited by the need to accommodate pedestrian access. The pedestrian zone in a commercial area is recommended to be a minimum of 1.8m wide to allow for the adequate flow of pedestrians, strollers, and wheelchairs. This area should be clear of all obstructions and generally cannot extend into an open tree pit area. Staff will review the impacts on other sidewalk amenities, like café seating, patios, and produce displays on a case by case basis. In these pedestrian areas, the tree pits will be covered with granite screenings, a level and permeable surface, to minimize trip hazards and mud. However, Council should be aware that the City receives occasional complaints regarding the tracking of these screenings onto the sidewalks and into stores.

Procedures to enhance tree retention by building tree trenches, installing structural soil or installing root barriers were reviewed by the Arborist but were considered too disruptive to the existing root systems and would likely result in the loss of additional trees.

Permeable Surfaces

Permeable sidewalks and/or utility strips are considered in areas where the redirected water can be absorbed by the ground without causing potential flooding to properties or damage to other infrastructure.

Soil permeability studies were previously undertaken in the West Broadway area as part of the City's storm water management reviews. These studies indicate that the area's soils consist of clays and other low permeability soils which means there is very limited ability for

the ground to allow for the infiltration of additional water. This soil type was reconfirmed during recent excavation of West Broadway for sewer and water rehabilitation. Given the poorly draining soils in the area, permeable surfaces, such as pavers, would require additional sub-surface measures to avoid potential water saturation and flooding. This would take the form of a sub-surface detention and drainage system to act as an "overflow" when the ground becomes saturated. Installing these works would require removal of significant root structures around existing trees and would cause further tree damage. In addition, the overflow system would cost approximately $500,000.

At the previous Council meeting, a delegation from the manufacturer of permeable pavers supplied a unit cost estimate for the installation of a permeable surface. Based on this information, to install a permeable paver surface would increase the cost of this project by approximately $600,000. To replace just the utility strip with pavers would increase the cost by approximately $250,000.

Increases in permeability can be achieved where water can be absorbed into the surface soils to be used by the new plants. An additional 150 square meters of planting areas have been identified, so approximately 1200 square meters of new planting areas will be installed as part of this project, particularly in the new pedestrian and bus bulge locations.

Permeability can also be increased in those areas which detain the infiltration of water but ultimately return water to the storm water system. Three infiltration catch basins have been identified where grades and pedestrian access needs can be accommodated.

New Trees

Where new trees are planted, the larger tree pit will be used where possible and will include appropriate soils to promote growth and installation of a root barrier to prevent future heaving of the sidewalks. New tree types will be planted to complement the Linden trees, fill the gaps in the tree line, and grow to re-establish the tree canopy. Furthermore, the new trees provide for diversity of the urban forest by ensuring the age and type of the trees vary so that all trees do not die off at the same time or all suffer from species-specific disease or infestations.

The City Arborist recommends that a cultivar of the Persian ironwood is the most suitable tree for this area as they will complement the size, form and foliage of the existing linden, are pest free and are better suited to minimize future sidewalk impacts. Two cultivars are under consideration, the Vanessa and Ruby Vase, and the largest and healthiest cultivar available will be selected when tree planting is undertaken.

FINANCIAL IMPLICATIONS

The suggested approaches of using pavers, tree trenches, and/or structural soil were found to have no functional benefits in this situation, are not proposed, and could increase the project costs by an estimated $750,000 to $1.1 million or more. Alternative measures that will be undertaken (enlarged tree pits, new planting areas, infiltration bulges) can be covered by the existing project budget and scope. This project committed the entire City portion of the 2007 Basic Capital Budget for sidewalk rehabilitation of $1.5 million.

IMPLEMENTATION PLAN

The measures outlined in this report will be added to the Invitation to Tender for the West Broadway reconstruction contract which closes in March. The contract will be presented to Council in early April for award. Sidewalk construction is anticipated to be completed by late summer, with provisions to ensure full access to the area for Greek Days in late June. Tree planting will occur after the summer when conditions are suitable for transplanting.

There are a number of root conflicts which must be dealt to re-establish a safe sidewalk. No feasible alternatives are available to enable the full rehabilitation of the sidewalk without addressing root conflicts in specific areas. If tree root conflicts are not addressed, rehabilitation is not feasible and trip hazards and sidewalk flooding will remain. Increased temporary measures such as asphalt filleting would be required to mitigate risks in those locations.

CONCLUSION

The Arborist reports that that approximately 204 of the 249 existing trees will be successfully retained and an additional 10 new tree locations have been identified. The existing Lindens will continue to grow, albeit with further heaving of the sidewalk. However, disruption of the sidewalk by the existing Lindens will be partially controlled through the use of larger tree openings and retaining trees with deeper root structures. New trees will grow into and enhance the existing tree canopy and are not expected to result in significant maintenance issues due to the new tree installation procedures and the type of tree used.

The Engineer reports that the sidewalk design for West Broadway accommodates trees where possible through enlarged tree openings. Permeability of the sidewalk surfaces will be accommodated through the installation of 1200 square meters of landscaping and 3 infiltrating catch basins. These changes in design can be made at no additional cost to the project while maintaining the goal to re-establish a safe sidewalk and provide for a sidewalk more able to resist the ongoing disruption from tree roots.

Staff are seeing ongoing risk management claims arising out of sidewalk heaving from boulevard tree plantings, and escalating complaints of standing water from rainfall. This reports outlines efforts which can be made to retain trees and increase sidewalk permeability and also reconfirms that the remaining roots conflicts must be dealt with to remove trip hazards and flooding of the sidewalk.

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Trees and Sidewalks on West Broadway

West Broadway, Report to Council, March 2007, prepared by
Larry Allen Benge, Residential and Landscape Designer

In October, 2006, City Council requested that staff report back to Council 'as soon as possible' with options and budgets for sidewalk treatments on West Broadway. Council also directed that staff 'replace those trees that are absolutely required to be removed with specimens that will match the existing Linden canopy'. More than three months later, we are still awaiting the report.

As a result, this is a commentary on a report I have not seen, as yet. It is based on a review of the information thought to be most current, and some information rumoured but not confirmed in writing. I will be as brief as possible.

Everyone agrees that substantial remedial and maintenance work needs to be done on West Broadway. The present street work in progress is much needed and appreciated, and is proceeding at a commendable pace. The proposed Pedestrian and Bus Bulges, and the redesign of the existing mini-parks are positive additions. The need to rebuild the sidewalks to provide a safe environment for all users is clear.

The contentious issues boil down to sidewalk types and installation, and trees: their retention, their removal and replacement, and providing the conditions for new and continued growth without effecting the safety of the adjacent sidewalks. These issues are linked.

Sidewalks
Sidewalks must be safe, must properly drain water away from the adjacent buildings and businesses, and must be easily maintained. They can also be interesting, detailed, even fanciful. But budgetary considerations usually remove these options! On West Broadway they drain water towards the street and the trees along the street edge. While my first choice for sidewalk materials would be permeable pavers, as they provide both a direct way to deal with much of the rainwater and provide a better environment for the trees, I don't have a huge problem with the City's proposed broom finish concrete. I do, however, feel I must question the removal of existing interlocking pavers in areas where there are no apparent problems with puddling or root humping. This is an existing surface which still functions well and is in good shape after many years of use, can be easily matched as a neighbor to the concrete, and serves to build some diversity of sidewalk materials. Not to mention the budgetary savings which would result. This brings us to the trees.

Trees
During the many community meetings which the City held to consult with the neighborhood, the oft repeated and overriding comment was "Save the Trees". Everyone has commented on the beautiful canopy that the trees form, the scale and definition to the streetscape that the trees provide, the many environmental benefits of the large trees, etc. I agree with all these statements, but feel the need to address other concerns in this space.

First, the matter of removing some of the existing trees. While there exist some obvious candidates for removal and replacement, other trees scheduled for the axe raise questions. When I printed out the maps and tree-by-tree analysis from the City website, and then proceeded to walk the length of the project site along Broadway examining each tree, there seemed to be some inconsistencies. I attempted to decipher some criteria for saving or removing, but was regularly confused. Sometimes there were two trees located beside each other, with similar root humping or lack thereof, and one would be slated to go, the other to survive in place. Some trees marked for removal exhibited no lifting of sidewalk or surrounding grade. Some trees with comments of '12" heave' had no heave at all! More than a few trees marked for removal had localized root humps which could be accommodated within the proposed 6' x 8' tree openings, while others exhibited some roots under the sidewalk which may be pruned without damage to the tree. These could be better investigated with the use of the ground radar technology which the City possesses, but that information has not been released to the public, despite many requests.

Second, the matter of replacements for those trees removed. The canopy created by the Linden's size and spread is it's strongest element, and should be preserved. Any replacement trees should be of a size and shape as similar to the Lindens as possible, if not actual Lindens, the first choice. They should be as large as possible when planted, so there is little or no delay in re-establishing what is lost. There has been mention of using a Maple tree(what cultivar?) as a replacement; if the Maples the City has planted along the 2600 block are any clue, they are too small (20-25' ht.) and a slow grower, so not nearly a Linden-type (60-90' ht. if unpruned). Also, the present trees are pruned so bottom branches are 12-15 feet above ground and storefront signage is visible from drivers in the street; imagine a 20-25 foot tree pruned to 15 feet above ground.

Third, and very importantly, the tree root zone. This area between sidewalk and curb is critical for the trees and for drainage of sidewalks. It should run in a continuous strip between tree openings. It should be covered in permeable pavers, so as to allow the tree roots to breathe, and water to drain. To cover this area with exposed aggregate concrete, as proposed, is to ask for a repeat of our present problems some years down the road. With permeable pavers , and proper soil below, water drains deep into soil, and roots follow. With concrete slabs, the ground is sealed, with condensation on the underside of the slab, roots stay close to the surface, get larger over time, and heaving begins again. It has been said that in the winter a root zone with permeable pavers will become saturated with water and unable to drain properly. But with a proper slope from building front to curb, even if the zone becomes saturated, the water will flow over the top to the curb, then gutter, then sewer as it is intended.

The Linden tree canopy along West Broadway is an important part of the neighborhood's experience of that street. Many people, and not only from the immediate neighborhood, shop there and eat at the restaurants and outdoor cafes under it's branches. It must be preserved for these people's enjoyment, as well as for future visitors. Providing a good root zone for the trees, choosing the right paving system, removing as few existing trees as possible, and replacing removed trees with Lindens or a species of like size and habit, along with establishing safe sidewalks will help to accomplish this.

As an addendum, I must mention that while the City is trying to be very accommodating in it's dissemination of information regarding West Broadway, it is bothersome that certain specific information is so difficult or impossible to obtain. I have mentioned earlier the root-scanning radar technology and the total lack of any information regarding the results of the City's efforts; the contradictions between street mapping and individual tree status statements from the City's website; the lack of consistent criteria for tree removal; clear budget figures and specific design details. I would hope in the future this type of information would be more readily available.

I have tried to be brief and concise. I hope to have succeeded. Thank you for taking the time to read this. In your deliberations, my wish is that this is helpful to you.

Large Stature Trees and Safe Sidewalks

West Broadway Report to Council, by Randy Sharp, Landscape Architect and Urban Designer

The City of Vancouver is to be commended for implementing transit improvements, separate storm sewers and safe pedestrian crosswalks for Broadway. The City is initiating programs to address climate change, energy conservation, air quality and livability. Older trees provide immediate benefits. Typically, each tree stores 2,000 kg of carbon, cools the ambient temperature by 5°C, intercepts stormwater, filters the air and creates a quieter environment. The large trees absorb the sound and the diesel fumes from the 99 B-Line buses and numerous trucks. The many outdoor cafes and produce stands that define West Broadway also benefit from the continuous cool canopy provided by the Lindens.

The technology of large stature trees, supported by safe permeable pavements, is very successful in major cities across North America. Municipal programs include Urban Forestry Services (Toronto), Green Factor (Seattle), Cool Cities (Los Angeles), and the New York tradition of big trees, continuous tree trenches and permeable paving stones. This report discusses cost effective technical solutions presented to the City at several meetings. Experts reviewed the City Arborist's report posted on the website, and recent design features proposed by City staff.

Large Stature Trees

The City will be providing 6' x 8' openings for all new and existing trees, surfaced in granite chippings (no fines). These beneficial open bases for the trees will allow for retention of nearly all of the 45 large Lindens designated by the City for removal.

The trees were evaluated independently by two arborists; Colin Varner and Tony Puddicombe (International Society of Arborists), and by Larry Benge, a design professional. These experts reported that the Lindens are in excellent health, and with some pruning, will prosper on Broadway for many decades. They concluded that currently, 10 - 15 Lindens may need replacement because of excessive heaving and major root growth crossing sidewalks. These trees require closer evaluation by ground penetrating radar, and by careful removal of concrete slabs to determine the exact condition of the roots. The City indicated that pavement openings, slightly wider or longer than the proposed 6' x 8', can be provided in some locations.

Replacement trees should match the existing specimens, as directed by Council. A Linden cultivar, Tilia cordata 'Greenspire', is recommended for Seattle streets, and commonly used by cities across North America. The variety 'Greenspire' is 'excellent for street tree planting' (quoted in several tree manuals). 'Greenspire' and similar cultivars are currently available in sufficient quantities in 4" caliper, 16' height, at local nurseries.

The City is proposing 45 small maples (2" caliper, 8' height) as replacements. Maples are not recommended for this section of Broadway, and trees under 3" in caliper are prone to vandalism. The proposed maple has a different form, a different leaf pattern and coloration, and will take 40 years to match the Lindens in height. The shorter maples will also block views of the storefronts and commercial signs from the street. From an urban design point of view, the continuous green-tunnel of Lindens truly defines West Broadway as a unique shopping district.

Options for Safe Sidewalk Treatment
On October 19th, Council asked staff to report back, as soon as possible, on options for sidewalk treatment to 1) retain trees, 2) increase permeability of sidewalks, 3) options for pavers, tree trenches and/or structural soil, and 4) specimen trees to match the Lindens.

The unsafe and hazardous condition of the existing sidewalks is a result of concrete slabs drawing water up to the surface by condensation, and by attracting surface tree roots that expand. Cast-in-place (CIP) concrete slabs lift, crack and fracture at joints creating tripping hazards. The hexagonal concrete patio slabs are also a problem and should also be removed immediately. The following options or combinations are recommended:

A. INTERLOCKING PERMEABLE SIDEWALK: The entire width of the sidewalk is surfaced in an porous paving system that allows rainwater infiltration over a wide area. Several sections of the sidewalk have a cross slope gradient of less than 1%, which will pond water unless area drains (not recommended) or permeable pavers are installed. The interlocking sidewalks are fully ADA (American Disability Association) compliant. Vacuum sweeping pavers 2 or 3 times a year using existing City equipment is suggested.

B. CONVENTIONAL INTERLOCKING PAVERS currently exist in the sidewalks and are in good condition in the 2700 block (Scotia Bank), 2900 block (Blenz), 3100 block (Kisilano Sushi, the CW Bank), and 3200 block (Blockbuster). The City saves the cost of removal and reinstatement ($12 per sq ft). These engineered interlocking Uni-Decor pavers are safe and generally in good condition. The utility strip between the trees is surfaced in permeable pavers. No heaving, no puddles, ADA, and least cost solution.

C. CAST CONCRETE SIDEWALK, with INTERLOCKING PERMEABLE paving in the utility strip between the trees. Air, water and nutrients are supplied deep down to the tree roots. No condensation, no heaving, and meets ADA requirements. For all options, a continuous root barrier is installed in a trench lengthwise behind the trees backfilled with drain rock. The City has indicated that all trenching in the vicinity of tree roots will use hydro-excavation, and that a City Arborist is to be present at all times.

Exposed aggregate cast concrete as a 'decorative finish' is not recommended in the utility zone. The same lifting and cracking will occur in 15 years. Cast concrete sidewalks seal off the ground surface, water condenses and attracts roots to the surface. The exposed aggregate surface, comprised of round pea gravel, is slippery and unsafe. Interlocking concrete paving is very durable, twice the strength and uses 50% less material in comparison to the City standard concrete sidewalk. Interlocking concrete pavers form a tight web (no tripping edges) and have a high slip resistance, refer to www.icpi.org. At stakeholder and merchant meetings in the Fall of 2005, the City promised coloured interlocking concrete pavers for the utility strips as the decorative paving for West Broadway, not the grey exposed aggregate, now proposed.

In summary, the large stature Linden trees form a continuous canopy, defining what is unique about West Broadway. Permeable pavers are safe and allow for drainage, air and nutrients deep down to tree roots, creating the environment to grow large urban trees. Council has an outstanding opportunity to implement, as soon as possible, safe and cost effective solutions

for Broadway, and for the entire City. The green technology exists today to reduce the urban heat island effect in Vancouver, a contributor to global warming.

West Broadway Business Committee

Comments forthcoming.