



Morris Arboretum's Urban Forestry Consultants

*The arboretum of the University of Pennsylvania and the
official arboretum of the Commonwealth of Pennsylvania
9414 Meadowbrook Avenue, Philadelphia, PA 19118*

07.11.13

Deborah Nemiroff
Hunt Engineering Company
22 East King Street
PO Box 537
Malvern, PA 19355

RE: Brick Walkway at 2nd Bank Building – National Park Service

Dear Deborah:

At your company's request, I met you and Kathryn Diserens from the National Park Service to inspect tree-related issues for the brick walkway around the 2nd Bank building at Independence Square on 09 July 2013. This report details findings, discussions, and recommendations from my site visit.

My assignment was to recommend methods to prevent stormwater from the brick walkway entering the adjacent Library Hall entrance and to diminish the risk from visitors tripping on bricks displaced by root growth without harming the trees, and to advise and offer other tree-related recommendations.

FINDINGS & OBSERVATIONS

- **Brick walkway on sand bed:** You stated that the brick walkway adjacent to the 2nd Bank building is constructed with a brick herringbone tread on a sand base. No excavation was done during my site visit; however, this seems reasonable given how the brick is being displaced by root expansion.
- **Root growth/stormwater issues:** The London planetrees have roots growing across the walkway, in an east-west direction (Photo 1). The root's radial expansion is visually apparent and has created small humps which direct stormwater flow to the west. This root growth



Photo 1: Kathryn (NPS) and Debby (Hunt Engineering) standing on area that is raised from tree root growth (note hump on tree pit border). This raised area is directing stormwater towards Library Hall entrance on right.

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Jason Lubar: Associate Director of Urban Forestry • 215-247-5777 x189 • email: lubar@upenn.edu
Robert Wells: Associate Director of Outreach Arboriculture • 215-247-5777 x144 • email: wellsrob@upenn.edu
Fax: 215- 247-1635 – page 1

results in small areas where stormwater ponds as well (Photo 4).

The roots of the southwestern-most tree are causing stormwater to flow towards Library hall where, purportedly during extreme rain events, stormwater flows over the ~1" high threshold into the building.

- **Brick Displacement:** Many bricks have been displaced by root growth; nearly all of the displaced bricks are directly adjacent to the tree pits (Photo 2).

- **Trees clogging gutters/drains:** Kathryn stated that the 2nd Bank building's roof gutters were being clogged by the London plane's leaves and seeds, and that the trench drains in the basement access walkway (Photo 3) get clogged with seeds.

- **Other findings and observations:**

- Part of the walkway has been patched with concrete from relatively recent electrical work
- There is a steam line that runs under the walkway that was installed in the mid-1980's
- There is less root-related damage on the Bank's east side
- The London planetrees seemed to be in good biological and structural health

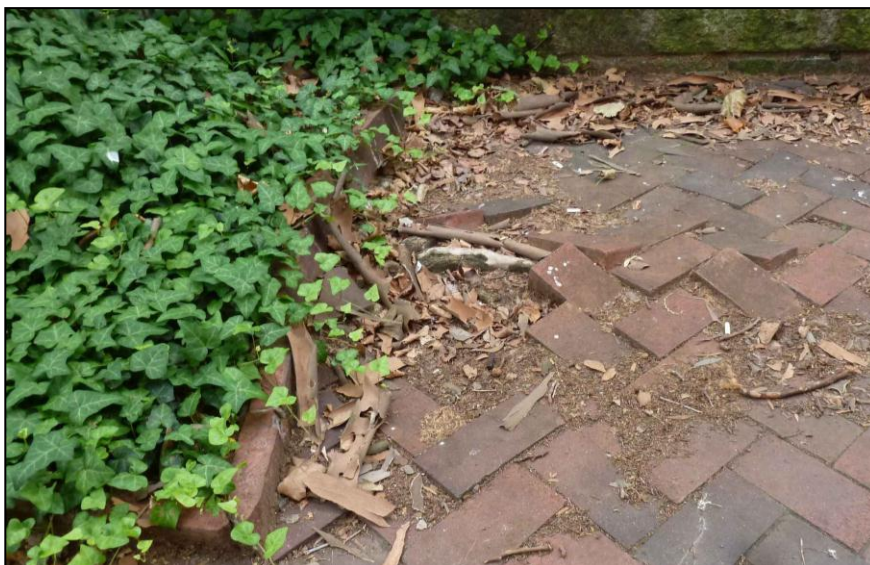


Photo 2: Tree roots displacing brick just outside of tree pit.

DISCUSSIONS

Stormwater issues: The goal for stormwater runoff is to have it flow down the middle of the walkway and into the drain on the southeast side without ponding or overflowing into Library Hall. One way this can be accomplished without harming tree roots is by installing ½ thickness frost-resistant bricks in the walkway's center in such a way as to join the full-size bricks evenly, without causing a tripping hazard. This will decrease the present brick level about 1 ½ inches, perhaps more if there is clearance between the brick and tree roots. If the Library Hall entrance requires more protection from runoff, walkway bricks could be raised gently to become level with the marble threshold; however, this may conflict with the historical fabric of Library Hall as the threshold was originally elevated from the sidewalk given that it has a full bullnose (1/2 rounded face). All brickwork should be done without damaging tree roots.

Areas of water ponding should be identified and demarked; and the present bricks could be lifted, sand backfilled and reset to reduce or eliminate water ponding.

Since tree roots will continue to radially expand, installing ½ thickness bricks should not be considered a permanent fix; however, it will add about 20-30 years useful life to the walkway, since tree roots typically expand much less on the upper side than the lower side.

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Roof and trench drain clogging:

Trees provide many documented benefits such as shade, oxygen, and pollution reduction.

However, they are living organisms that must be maintained, especially in an urban setting. Part of that maintenance includes cleaning roof gutters and trench drains. These types of drainage devices must be periodically cleaned to function properly. Cleaning drains becomes a vital activity during the late summer-fall or when leaves and seeds drop.

Decision makers must balance the positive contributions of trees with the cost of infrastructure maintenance.



Photo 3: Trench drain on basement walkway

Tree retention/replacement decision:

In the long-term, it may be decided to replace the entire walkway with a surface treatment, such as brick, on a concrete bed. The existing trees probably will not survive the impacts from construction, so new trees should be planned in this case. Also, removing the existing trees and resetting the current walkway will also alleviate tree-related issues; however, this must be weighed with the benefits that the current trees provide, as the planetrees are an integral part of the 2nd Bank block's canopy, which cools this area especially during the summer months which is the high season for tourist visitation.

Brick displacement issues:

The most egregious brick displacement issues occur around the tree's base, where structural roots must expand more radically to hold the tree upright. Therefore, to largely eliminate tripping hazards from displaced bricks, it would be prudent to expand the tree pits from five foot wide to 15 feet wide and add about two feet of width (east-west) to the pits. Quadrupling the tree pit's area will also benefit the tree, as small tree pits constrict tree growth. Increasing the pit size will not substantially impact/constrict pedestrians using the walkway.

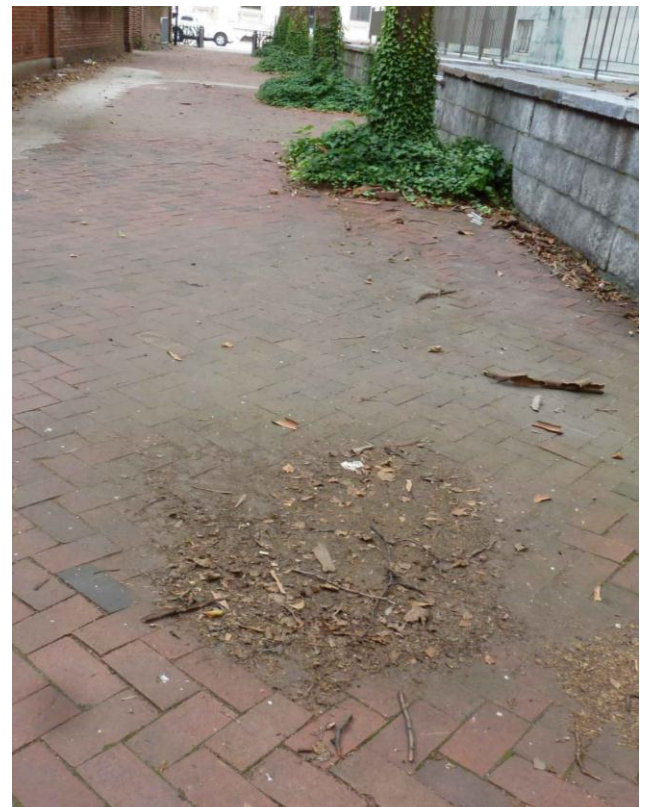


Photo 4: Stormwater ponding behind raise in grade due to of root growth.

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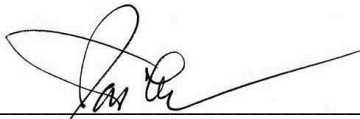
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RECOMMENDATIONS

- In the area between the most southwestern tree and Library Hall entrance, install ½ thickness frost-resistant bricks in the walkway's center in such a way as to join full-size bricks evenly, without causing a tripping hazard. This should be done in such a way as to encourage stormwater to flow down the walkway's center.
- Increase all of the west-side tree pits from 5' x 5' to 15' x 7' to eliminate tripping hazards. Care should be taken when bricks are removed/installed not to wound tree roots. Removed walkway bricks should be retained and used to patch the area of concrete from the electrical repair. Fill in new pit areas with high-quality topsoil.
- If budgets allow, increase the east side tree pits as well to maintain the bank buildings design symmetry and to alleviate present and future brick displacement.
- Identify and demark areas of stormwater ponding on the walkway. Within these areas, lift the bricks and backfill enough sand so that the areas will be level with or above the surrounding walkway when the bricks are reinstalled.
- Establish a maintenance program for the roof and trench drains that anticipates the timing of seed and leaf fall.
- Remove the ivy and Virginia creeper from the tree trunks every two years at minimum.
- If stormwater flowing into the stem vent access grate is not desirable, raise the bricks around the steam vent access so that stormwater will flow around and not into it.

If you have any further questions about our findings, discussions, and recommendations, please give me a call at your convenience.

Respectfully submitted,



Jason Lubar, ISA BCMA
Associate Director of Urban Forestry
Morris Arboretum

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