— LANDSCAPING PLAN: TREES —
(INCLUDES SPECIES FACTSHEETS AND "APPENDIX B")

January 10, 2022

Planning Board
8 Newmarket Road
Durham, NH 03824

Re: Mill Plaza Redevelopment. 7 Mill Road. Continued review of application for site plan and conditional use for mixed-use redevelopment project, drive-through facility for bank, and activity within the wetland and shoreland overlay districts. Colonial Durham Associates, property owner….Central Business District. Map 5, Lot 1-1.

Dear Planning Board members:

First, I'd like to acknowledge that CDA's landscape architect, Howard Snyder, has worked creatively within seriously challenging constraints to provide variety and interest to the landscaping of this prominent project. I hope that my below concerns will be viewed as an aid to ensuring that, if the application is approved, his landscaping plan results in what the Board and the community expects to see evolve within a reasonable timeframe.

The landscaping—particularly the shade trees—will be the face of the redevelopment to much of the public for decades into the future. CDA's December 2021 Proposed Property Management Plan notes: **"The primary goal is to make Mill Plaza's appearance as a "Gateway" into the town of Durham."** Please keep these two points in mind.

This letter is part of a "landscaping package;" the following documents submitted separately, with others perhaps to follow, e.g., regarding the "Restoration Plan":

1) Comparison of proposed plant species and Appendix B of our site plan regulations
   - CDA/Harriman's Emily Innes stated on June 10, 2020 that "we are drawing from the tree list and list of shrubs that's provided on the Town of Durham's website as the recommended trees" [referring to the Appendix]. Inclusion on that list does not necessarily mean suitability for this specific site or location onsite.
   - Incluedes links to specified tree specs and photographs, primarily from (a) Missouri Botanical Garden's ("MOBOT") Plant Finder—a resource also recommended by Mr. Snyder. See also Cornell University's Horticultural Institute, e.g., "Recommended Urban Trees."

2) Landscaping Notes on the December 1, 2021 site plan Sheet G-101, transcribed, with comments by Robin Mower and retired urban forester John Parry

Regards,

Robin

What I'm worried about: 10 landscaping concerns.....

1) **Will the plan result in a long-term healthy and attractive landscape for Durham residents and Plaza patrons?** Or will the site only look pretty when the doors open but not so much as the years pass?

2) **Trees vs parking**: Will the Board trade off the numerous functional benefits of additional shade-tree canopy for excess parking, despite documentation that parking spaces are not needed by Hannaford/Rite Aid and Board members' explicit preference for more and/or "big, mature" trees?

3) Are **trees taking a backseat** to perennials (413 listed) and shrubs in the landscape budget for the parking area (only 1 tree per planting island)?

4) Will the new trees thrive, i.e., remain **healthy and survive to maturity**?

5) **Mature size and longevity: What, exactly, is realistic for each species?**
Will the proposed trees provide as much shade and passive cooling as "promised"—or, at least, as anticipated?

6) **Climate change** is driving pests and diseases into this region; the benefits of large mature trees will become even more valuable over time. Could we do better?

7) **Protection of existing trees** immediately adjacent to the parking lot and areas of construction: Are measures shown on the plans sufficient? (Durham's record of tree damage or loss during construction is not laudable.)

8) Is **plant species selection** appropriate in all cases?

Trees that may be unsuitable for parking lots due to their large surface roots include the proposed red maple, hackberry, and river birch, as noted by Virginia Tech in its "Trees for Parking Lots and Paved Areas"

Trees may be at the edge of, or beyond, their natural growing range, such as the hackberry, or the American hornbeam, aka, blue-beech, which, as Lorne Parnell noted on June 17, 2020, also "tends to take a fair amount of water"

What happens if the cultivar selected for its specific characteristics is not available?

Salt tolerance varies among the designated "shade trees for parking areas."

9) Are the roots of the maples in the **raised planters**—or even the tree boxes—around the buildings likely to become so constrained that the trees decline or die?

In other conditions, they grow 50 to 70 feet tall, a height that must be supported by root growth. There's a limit to how well a tree/plant can grow if it's not in the right location with the right conditions.

Perhaps it would be better to start off with another, smaller species, as John Parry suggested (John Parry 1-6-22).

10) Does the Board know how to **evaluate the "subsurface advancements"** referred to by Mr. Snyder on June 17, 2020 and proposed planting techniques shown on plans?

Will there really be **enough soil volume** for that anticipated tree growth, and will the areas to be landscaped be adequately prepared for new plantings? (See John Parry 1-6-22) Soil under the existing pavement and buildings likely is "construction-damaged," with decades-old problems that may dictate replacement rather than simply soil amendment.

Guidelines to consider, per conversation with John Parry ("standard practice") .....

- Goals. Trees should:
  - Survive and be healthy for a defined reasonable length of time;
  - Have a canopy as large as possible, given the site and conditions; and
  - Be large enough to provide identified functions/benefits, e.g., reduce stormwater runoff, shade buildings for energy conservation, provide a visual screening, etc.
- If trees are pictured in plans (including in perspectives or renderings), and conceptual drawings are reviewed and approved by the Planning Board, then the trees planted should reach that depicted mature size (or a size specified in consultation with the landscape architect) after X number of years.
- **All reasonable steps required for trees to reach that size should be part of the reviewed and approved plan** (site design, soil, rooting and overhead space, species selection, proper planting, warranty, watering/maintenance/protection, etc.).

Mature size and longevity, expected vs reality .....

What kind of reduction in mature size and growth rate for each species is realistic?

Research indicates a real-world discrepancy between design expectations and reality 20 years after tree planting (see "20 Years Later," below).

Mr. Snyder briefly stated at the June 17, 2020 Planning Board meeting that with the "great advancements in the last 20 years or so of providing better conditions for these trees subsurface so their life expectancy is extended longer."

What are those "advancements?" How fully does CDA plan to implement the them? Is there adequate physical space on the site and funding in the landscaping budget?

Discrepancies in information presented?

The legend below is excerpted from CDA's diagram, presented on June 17, 2020. Dimensions shown do not all match those on the site plan Planting Sheets L2.1–3.

Shade Trees at Parking Areas			At Maturity		On Appendix B
			Height	Spread	
1	Acer rubrum October Glory	Red Maple	40-50 feet	30-40 feet	●
2	Celtis occidentalis	Common Hackberry	40-60 feet	40-60 feet	●
3	Nyssa sylvatica var. Marshall	Blackgum	30-50 feet	20-30 feet	●
4	Ginko biloba "Princeton Sentry"	Maidenhair Tree (male only)	40-50 feet	20-30 feet	●
5	Carpinus caroliniana	American Hornbeam	20-35 feet	20-35 feet	●

#1: 'October Glory' red maple (*Acer rubrum*) (8 planned)—Dimensions on the above diagram show 40–50 ft H x 30–40 ft W; Sheet L2.2 shows 50 ft Hx30 ft W:

Acer rubrum October Glory 2.0" - 2.5" Cal.
October Glory Red Maple 50'ht x 30'w

#2: Common hackberry (*Celtis occidentalis*) (5 planned)—Dimensions on the above diagram show 40–60 ft H x 40–60 ft W; Sheet L2.2 shows 40 ft Hx30 ft W:

Celtis occidentalis 2.0" - 2.5" Cal.
Common Hackberry 40'ht x 30'w

Note on the December 1, 2021 Sheet L2.2 Planting Plan:

3. Height and width noted for each plant species represents the anticipated plant size at maturity given known and anticipated site conditions, and without pruning and other maintenance operations.

Does either set of information reflect "anticipated site conditions?"

Has the applicant provided specific species information, including about the expected growth rate? For example, how well will the maples in the planters between 3- and 4-story Buildings B and C do, with what I expect will be limited sun?

Planning Board discussion with landscape architect

At the June 17, 2020 meeting with landscape architect Howard Snyder, members also expressed interest in what we could expect to see for tree growth in the parking area.

James Bubar said: "…I've looked at the parking lot and the five different tree types that they're planning on putting in—I really couldn't read the types of trees—but I'd really like to see a graphic that shows me the shade covering at 1:00 in the afternoon ten years from now. I just don't understand how big those trees are going to be." *[DCAT marker about 1:19:20]*

Then, about DCAT marker 1:38:25 (emphasis added; see more complete verbatim transcriptions submitted separately):

Rasmussen: I have a couple of follow-up questions regarding the trees. The legend has dimensions at maturity. Under these conditions, would we expect the trees to reach full maturity, and how long would that take?

Snyder: By the nature of the trees being planted in the locations shown, it is, the expectation would be that they would not achieve the same mature height as they would, as I said, out in the fields or in the woods. Their mature height is going to be a bit smaller, the canopy won't be quite as wide. We're providing soil conditions and locations we believe will give them the best growing medium. Now, in terms of growth, all these trees will grow at different rates. The maple tree, will be most likely be achieving their final height the soonest of the five.

Rasmussen: Would that be like, 10 years down the road, 15 years around the road?

Snyder: It's objective [sic]. I think the trees will probably take 15 years to achieve their mature heights, but they'll grow quicker in the beginning and slow later in their life.

Rasmussen: I just want to make sure we have the right expectations. Thank you.

[DCAT marker about 1:40:12]

Kelley: Mr. Snyder, if I could just add onto that, follow up on that question. Would trees in this sort of urban condition not be expected to live as long, as well, as if they were in the field or in the woods?

Snyder: It's, the life expectancy of a tree planted in urban conditions and streetscapes and parking areas is less than it would be out in their natural environment, if you will. But what has occurred is, there's been been **great advancements in the last 20 years or so of providing better conditions for these trees subsurface, so their life expectancy is extended longer.** When I first started out, and these types of engineered soils and structured soils didn't exist, so the life expectancy of these trees was at the most maybe 15 years, but now with these **advancements in these designs that allow more water and air filter to infiltrate below the surface, then these these trees can live at least twice as long.**

NOTE: The Board did not follow up to learn more about these "great advancements" or "engineered soils and structured soils."

Would road salt constrain growth leading to a smaller mature size?

Are the proposed species sufficiently **salt-tolerant**? (Do we just adjust our expectations?)

> …even though a plant can tolerate saline conditions, its growth may be reduced drastically. This is related to the difficulty roots experience when absorbing water from the soil— the saltier the soil solution, the harder it is for roots to draw water into the plant. In turn, this reduces water available for plants to increase cell size, **leading to smaller plants.** [Selecting Salt-Tolerant Native Trees for the Georgia Coast *(don't dismiss this good resource just because it is not local)*]

- These species may have no to moderate salt tolerance: ginkgo, red maple, blackgum (*Carpus caroliniana*), hackberry, river birch, redbud.
  Sources: USDA, UMaine, NYC Greenbelt Plant Center, Cornell's Recommended Urban Trees, Durham's Site Plan Regulations' Appendix B]
- Could any of the trees be adequately protected from road salt? Would "salt alternatives" such as those used by Durham's DPW have the same effect?
- Would larger amount of organically dynamic soil available to tree roots help?

Longevity for "urban trees": Right plant, right place .....

Soil volume is critical for root growth and related tree canopy. **How much soil should be available for each tree (in cubic feet)? What does CDA propose?**

Cornell's Urban Horticulture Institute notes (emphasis added):

> The major impediment to establishing trees in paved urban areas is the lack of an adequate volume of soil for tree root growth….**It is estimated that an urban tree in this type of setting lives for an average of only 7-10 years, where we could expect 50 or more years with better soil conditions.**

and urban foresters use a rule of thumb (one source, but found at numerous websites):

> Tree roots can extend two to three times the crown width. The larger the tree, the more extensive the root system. Minimum soil volumes for root space are suggested to be 1–2 ft [cu] for each square foot of projected mature crown (Lindsey and Bassuk 1991). Other formulas have derived minimum soil volumes based on trunk to crown diameter (Urban 2008). **Urban foresters generally adhere to the following soil volume minimums: 300 cubic feet for small trees, 600 cubic feet for medium trees, and 1,000 cubic feet for large trees.** [Cleveland Tree Plan's "Tree Selection Guide (2020)

Two visual examples follow of how **soil volume limits tree growth**. **The first is local.**

John Parry believes that the trees circled in the above photo are the same species, planted at the same time. The difference in growth may be attributed to the **difference in soil volume available to the roots.** The tree on the left has access to more soil than the trees on the right—which are bound on all sides by parking pavement.

The second example is taken from Cornell University's Urban Horticulture Institute's CU Structural Soil®: A Comprehensive Guide. The caption reads: *Everything else being equal, access to soil volume can make a substantial difference on tree growth*

How much soil volume does a tree need?

Everything else being equal, access to soil volume can make a substantial difference on tree growth

Medians, landscaped 6-foot wide = 5 feet at surface

The measure of a planting strip or a planting island width includes the two curbs, typically each 8 inches wide, reducing soil volume at the surface to approximately 5 feet, as John Parry has noted (John Parry 1-6-22). Planting diagrams show that engineered soil will extend beyond the median curbs, under the pavement, to support vehicle travel and reduce compaction, as intended.

Trees need organically dynamic loam at the root level. How will the limited amount of soil available for root growth in two of the four directions in the medians alter the growth patterns, e.g., shade canopy and height, of the trees proposed for these locations?

Additional concerns:

- Structural/engineered soil drains quickly (a large component is stone), so the watering plan should take that into account, particularly in these narrow median strips.
- Should drainage pipes also be installed? (See below diagram from Cornell.)

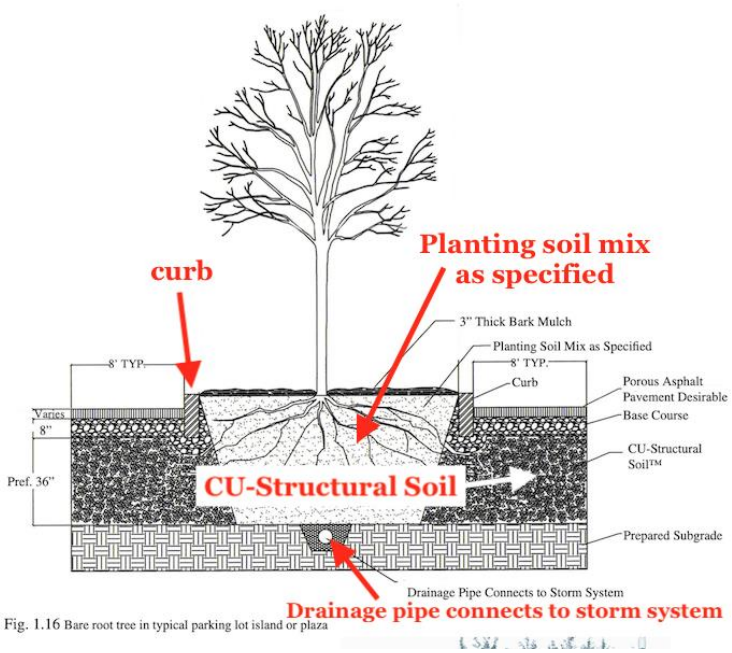

Fig. 1.16 Bare root tree in typical parking lot island or plaza

"Planting Island Detail" from Cornell's guide about using CU-soil (proprietary structural soil considered for use by CDA), showing drainage pipe.

Protection of existing trees to remain .....

Protection must include for any so-designated trees along Mill Road, not just along the property line toward Church Hill. Consult with Durham's Tree Warden.

Add notes on plan: Following standard practices, identify on the plan which trees are to be protected, perhaps in consultation with the Durham's Tree Warden. Include notes about

which of the types of protection detailed in the site plan drawings shall be used for each specific tree. (For example, "Type A" or "Type B.")

Engineered soil may help: Cornell University's Urban Horticulture Institute's CU Structural Soil®: A Comprehensive Guide (page 23):

> Sometimes planned construction activity and paving projects can threaten the root systems of mature trees. When extensive paving is planned in the root zone of mature existing trees, it is possible to use CU-Structural Soil® as a means to save the threatened tree.
>
> In preparation for new paving, the soil around existing tree roots can be excavated using a non-injurious method such as an air excavation tool. CU-Structural Soil® is then used as the base course for the new paving. Because the depth of the base course required for the pavement might mean that the paved area is "built up", on top of the tree roots, rather than "dug down" (which would destroy the roots), special design consideration must be given to the finished elevation of the final paving.

Open questions (continues to next page)

1) Is the plan **overwhelmed with perennials** (which require maintenance and perhaps replacements sooner than desired) and shrubs, so that we are losing sight of the bigger picture which, as Board members have stated, is: **"We want large mature trees that provide shading canopy?"**

2) **Engineered soil / structural soil: Are there differences in what CDA proposes?**
   - In CDA's Letter from Applicant Addressing Landscaping Questions 1-6-22, Joe Persechino notes: "The engineered soils are to be CU-Soil ®, or Utelite Urban Tree Structural Soil, or equivalent. Construction level specifications can be provided, if required, as a Conditions of Approval."
   - **Ask the applicant to address the differences in the engineered soils under consideration.**
   - Given the importance of the engineered/structural soil in ensuring the health of proposed new tree plantings, together with variations in "engineered soil" mixes, the Board should indeed require specs.
   - The booklet "Using CU-Structural Soil™ in the Urban Environment" "details how Cornell's proprietary mix "meets soil needs of urban trees while also fulfilling engineers' load-bearing requirements." Utelite may provide something similar.
   - Should the planting media—including soil and "engineered soil"—be different for different trees, or in different areas of the site?
   - Is the **volume** of engineered or structural soil appropriate in each case where used? John Parry 12-15-21 and (John Parry 1-6-22)

3) **"Typical planting" techniques may be inadequate**.
Will the construction plans or Conditions of Approval specify techniques for specific plant materials in specific areas on the site?
   - Will all currently-hardscaped landscaping areas be "remediated" for planting? (Will the soil be appropriately amended with organic material or replaced entirely? Will pH issues be addressed?)
   - Notes on Sheet L3.0 Tree Planting Details, include, for "Deciduous Tree Planting, Typical": 1. IN POOR SOIL CONDITIONS, ELEVATE ROOT BALL ON 12" OF COMPACTED SAND. Seems odd: Who determines whether this is appropriate?

> When planting trees and other plants in construction-damaged soils, you most likely are dealing with made soils both horizontally and vertically. These fabricated soils can be heavily compacted, polluted, and unfertile, full of trash and debris, have unhealthy high or low pH ranges, and have strange transition zones (hydrological differentiation) between mixed and crushed layers. These traits can all negatively impact tree establishment (root growth to support plant growth), normal growth and appearance, and plant longevity. [Understanding Tree Planting in Construction-Damaged Soils," from Penn State Extension.]

4) **Maintenance plan: Require terms in our CURRENT Site Plan Regulations, as appropriate, and as authorized under a CUP application.**
   - Current Site Plan Regulations: Section 5.10.1:… "a written, **3-year tree maintenance plan** shall be submitted that includes specifications for watering, mulching, removal of guy wires/stakes (if used), pruning, and tree protection." (This longer term is important also for rhododendrons; see below).
   - Mill Plaza Regulations require only a 2-year plan and 1-year guarantee.
   - Trees in the planting islands/medians could use a permanent watering plan: Structural soils drain quickly but the trees in these narrow, raised beds will need more than rainwater.
   - Whoever is identified for general maintenance perhaps should be XXX responsible for watering and removal of stakes.
   - Add to the Conditions of Approval: The choice of landscaping maintenance company shall be made in consultation with Durham's Tree Warden.

11) **Trees in raised planters at periphery of buildings**
   - trees will be fastigiate in nature, estimated canopy between 10 and 15 feet wide
   - Most references for the Freeman maple indicate a typical height of up to 70 feet. While trees may survive in raised planters, they may not thrive. Pruning to maintain size may be required but will reach the limit of effectiveness while maintaining tree health. Another, smaller tree may be preferrable.
   - 'Armstrong' will typically grow 40-60' (sometimes 70') tall with a very narrow, fastigiate (branches erect) form. [MOBOT]
   - Alternating species may also help lessen vulnerability to problems affecting any given species.]

12) **Tree boxes flush with the sidewalk around Buildings B and C**

- CDA proposes to plant trees in these boxes/planters that at maturity may be quite large, i.e., Freeman maples, which in some conditions grow as large as 50.00 to 70.00 feet H and 10.00 to 15.00 feet W, per Missouri Botanical Garden.
- Shouldn't CDA provide the Planning Board with basic construction details for these tree boxes prior to approval? (After approval is "too late" should there be any concerns.)
- For example, are they to be constructed as shown here?
  [CU-Structural Soil™ Graphics and Plan Views, Typical Street Planting View #1]
- "Important points: CU-Soil is not to be used where compaction is not needed, like the open area of a parking lot island. Ordinary good loam should be used in there. Use Structural Soil adjacent to the open area of a parking lot island under the pavement….."

  [January 7, 2022 email from Dr. Nina Bassuk, Director of the Urban Horticulture Institute at Cornell University, to John Parry and Robin Mower]

13) **Tree grates** on top of the flush-to-sidewalk "tree boxes" must be sized, installed, and maintained correctly. If not, they can become a problem as the tree diameter increases and may require cutting out and replacement.

> **The center hole in the grate must be enlarged as the tree grows, or else it will girdle the trunk.** Few communities have the budget to enlarge the grates as recommended….
>
> [James Urban, *Up by Roots: Healthy Soils and Trees in the Built Environment.* International Society of Arboriculture (ISA). 2008]

Questions from Planning Board members —answered? .....

Example: April 15, 2020 minutes

> Mr. Bubar noted that there was also a request from Mr. Kelley for the **definition of planting soil for the trees**, and the **size of the root mass that needed to be accommodated under the asphalt.** Ms. Innes said this information could be provided as well.
>
> Mr. Kelley said perhaps that could be shown in the planting details. He asked if an **irrigation system** had been contemplated. Ms. Innes said they had looked at that, and said it was understood that in the first few years the plantings would require **dip [drip] irrigation**. She said in general they were following the guidance in the Site Plan regulation regarding plants that were drought resistant so wouldn't need formal irrigation. But she said she'd heard interest from the Board about irrigation, and would see if changes needed to be made on that or not. Mr. Kelley asked Ms. Innes if she had seen the planting details. Ms. Innes said yes but not recently. **Mr. Kelley asked Ms. Innes if she would recommend aeration tubes in the planting areas. Ms. Innes said she would ask the landscaping team about this.**

Reference Notes.....

Background for realistic expectations for mature size of trees

Landscaping for the Mill Plaza site faces the usual parking lot challenges (e.g., removal of topsoil when originally constructed, years of asphalt cover and "construction-damaged soils," and typical urban pollutants such as oil, grease, and metals,) and:

(a) in this northern climate, road and airborne salt for snow maintenance;

(b) adjacent to College Brook on the one hand, with heavy marine clay, and, adjacent to Church Hill on the other, perhaps with ledge and/or shallow soils; and

(c) as John Parry (and others) points out, wherever planting islands or medians are to be located, the subsoil underneath may be in poor condition (including that it may be highly compacted). Those new planting areas require attention to soil quality, to drainage—for example, drain tile or pipe with gravel, and, paradoxically, to watering.

> It is unreasonable to assume that trees planted in parking lots will reach the same size dimensions as forest trees, or trees in park settings, or even published expectations. The design vision or planting plan may meet a proposed benchmark for expected canopy coverage minima, but **the reality over time is infrequently in line with the design expectation.** Few trees in paved environments reach their intended canopy dimensions prior to being replaced (Schwets and Brown, 2000). A reduction of size over time had been observed even when well-adapted species such as *Ulmus parvifolia* (Chinese elm) are planted as parking lot trees. In Gainesville, FL, the canopy size of *U. parvifolia* was restricted when the unpaved surrounding fell below 80m2 (Grabosky and Gilman, 2004).
>
> **...The data suggested that the current legislative and design growth canopy expectations are not being met if the published mature size is expected within 20 years**. Furthermore, the common planting zone soil access provisions resulted in much smaller tree sizes. In order to meet realistic expectations urban tree planting design, **the influence of soil resource provision must be acknowledged.** To meet the requirements for canopy legislation, either design choices could include larger planting spaces to yield greater size, or continue with current designs and lower size expectations, and compensate with an increase the total amount of trees planted. [Sanders, Jessica R. and Jason C. Grabosky. "20 Years Later: Does reduced soil area change overall tree growth?" *Urban Forestry & Urban Greening,* Volume 13, Issue 2, 2014, Pages 295-303.]