MEETING NOTES

ISSUE DATE
Dec 19, 2018

MEETING DATE
Nov 29, 2018

LOCATION
Cambridge Rindge and Latin School

CLIENT
City of Cambridge

PROJECT
Urban Forest Master Plan 2953

RE
Task Force Meeting 6

ATTENDEES
City of Cambridge Task Force
Reed Hilderbrand

Opening remarks by Owen O'Riordan
Owen noted that the reason for the cancellation of the last meeting was that the LiDAR data set that the consultants are basing their canopy analysis on needed to be reviewed for accuracy. The Urban Forest consultant team are the first ones to use it in the city, and we wanted to be sure that we're proceeding with correct data. The City is now satisfied with the data set.
In addition, each analyst has their own approach to creating a canopy layer, and the City wants to have a consistent methodology for the canopy change data. Consequently the City has asked UVM to produce a 2014-2018 canopy change analysis which will complement their 2009-14 analysis. The City expects a conclusion from UVM in late January or early February.
However, UVM's analysis won't change the overall finding that, from the perspective of land use, the recent canopy loss is mostly in residential areas.

RH reviewed the project schedule:
In the overall project timeline, we are done with the research phase, and climate modeling has just ended. We have some broad recommendations to review with you tonight.
We have been doing a lot of fieldwork such as collecting the soils, lab analysis, etc. which we will share with you tonight. We have also been coordinating with CCPR and Envision.

Design Team presentation outline:
- Soils analysis
- Climate model
- Response strategies
- Planning synergies

Soil Sampling

RH presented the results from soil condition analysis. Sites that were sampled were all public sites: street tree pits and several parks. Overall, the soil conditions for street trees are fair to poor in the sampled sites, with high levels of compaction, low nutrient cycling, and poor drainage characteristics. The team expected below optimal results as public plantings endure significant foot traffic.
These soil conditions can limit tree vitality.

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TF: What steps can be taken to improve the soils?
Some limiting factors can be remediated through management practices.

The sites are scattered around, to distribute them around the city. The black circles show the sample sites, we labeled them going from west to east.
We will not go through all the sites, but rather will review a few sites that are examples of the challenges faced. We will make all the test results available online.

Danehy Park soils tend to be poor, because it is artificial, a capped land fill, and not a natural soil profile.
Fresh Pond was the best site, a forest floor where the soil was very healthy.
Cambridge Common was compacted, because of the foot traffic. Along the public path, relatively sandy and dry.

Initial Analysis Result:
16 of the 20 sites have severe compaction. 12 sites had low nutrient levels and little to no available nitrogen. 7 sites showed poor drainage. Generally, there was an inconsistency in the texture, with presence of construction debris.

Possible remediation measures for limiting factors:
Compaction - Aeration can loosen compacted soils. The addition of compost over time can also loosen soils.
Low nutrient levels - Compost aids nutrient cycling.
Poor drainage – Best to address prior to planting but augering dry wells can help post-planting.
Texture - Difficult to address post-planting.

TF: How does aerating work?
Response: Compressed air introduces air pockets.

Sampling Sites:
One of the sites was in Alewife. The soils sampling sites were selected to align with the tree inventory sampling sites to correlate tree health with soils conditions. They took 5 samples from each site and combined the topsoil to create a representative sample of the area.
In this case, tree was planted high and it had burlap still on it from the nursery.
This slide [11] shows an example of the soils consultant summary page and

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the soils report pages.

Second site was a street in residential area of West Cambridge and is an example of poor drainage. Heavy wet clay was found 24”-36” down in the tree pits.

Third site was on Mass Ave, between Harvard and Porter Squares. Large and small trees and an empty tree pit were sampled. The soils were all very dry and compacted, no moisture at all. The samples were taken in August.

TF: We had lots of rain early this year. How about the salt levels?
Response: Only one site showed high salt levels. However, testing again in the spring would be good as the road salts may have washed out of the soils by August

TF: Is there a history of soil remediation of street trees?
Response: Our soils consultant has experience in a wide range of soils management.

Climate Model
The base assumptions behind the climate model were reviewed in previous meetings. We separated it out to two:
1- Baseline: Evaluating the threats of pests and disease along with increasing temperatures
2- Extreme event scenarios: a 100 year flood in 2030 and a moderate drought event that would reduce the urban canopy.

The increased threat of pests and diseases associated with a warming environment was found to have a significant impact on tree mortality. Drought was found to have a potentially moderate impact on the existing tree canopy.

The findings from this simulation will inform city-wide tree species recommendations and include location-specific selection criteria. We will see what species are doing well in specific locations, such as flood tolerant species in flood prone areas.

Baseline Scenarios:
The climate scenarios look only at gross loss, meaning we’re not accounting for replanting as part of the model. We are starting with the canopy today

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and projecting out to 2030 and 2070. With a small mortality annual rate, you still get a great loss in 2070. With 3% annual canopy loss, you have about 20% of the canopy remaining in 2070; with 4.5% and 6% annual loss, you have less than 10% canopy remaining. When you add the climate change effects, we see even higher losses.

Pests and Diseases:
For each species, we assigned either below average, average, or high threat according to the vulnerability to existing pests and diseases and those projected to move here as the climate warms.

Temperature Increase: Each species' hardiness zone is used to understand how the temperature change will effect the trees. In 2030, any species outside of zone 6b, will be removed from the model. This includes Black Ash, Bigtooth Aspen, Pin Cherry, Balsam Fir, Red Pine, and Tamarack. Only Red Pine has significant numbers in Cambridge (4.2 acres).
In 2070, any species that are outside of the 7a range, (11 species) will be removed.

We're not anticipating adding any southern species to the proposed species list, because extreme cold events are still expected to happen at least in the near-term future.
We are just looking how the current canopy changes with the current conditions here.

This slide [21] shows a part of the pests and diseases spreadsheet. We looked at the average lifespan of species, hardiness zone, flood and drought tolerance. Pests and diseases are organized according to their distance to Cambridge (250 miles, 500 miles and 750 miles). The closer ones may appear in the city by 2030.

This slide [22] shows the averaged result of the baseline scenario model run, 41.4% (+/-2%) of the 2018 canopy remains (gross loss assuming no replanting). This results in 10.5% total canopy cover in 2030. When compared to the baseline mortality loss (without higher mortality from pests, disease and higher tempratures) of 56% remaining canopy, this is an additional decrease of 26.1%. We don't want to underestimate the loss the City faces, that is why we want to show these numbers without replanting.

In terms of common street trees, honeylocust and zelkova perform higher

than average. Best performers are exotic species and small, short lived species.

Extreme Events:
Getting to the extreme events that we modeled, this slide [24] is a map of tree condition created by AES from LIDAR. They classified species conditions by using a leaf reflectivity ratio. For each individual species, we were able to generate the tree health condition correlated against condition ratings provided by Bartlett's 5% tree inventory. Purple is the trees in poor condition, orange shows fair condition and green shows the good condition. Some major avenues are notable for having poor and fair trees.

TF: Street trees are large trees. Does it measure the size of trees?
Response: No, just the conditions.

Moderate drought event is not a likely event, it happens once in 30 years within the 2035-2064 timeframe. But we don't know how the frequency of these events will change after 2030. Droughts are defined as deficits of 10% or more in monthly soil moisture relative to the climatological mean. Moderate drought duration is approximately 3-6 months. We actually experienced a moderate drought event recently in 2016. During a drought event, in the lower bound (less severe) scenrio, drought-intolerant trees in poor condition will experience mortality. In the upper bound (more severe) scenario, drought-intolerant trees in poor and fair condition and moderate drought tolerant trees in poor condition will experience mortality.

In our lower bound map [26], we would see additional 1.9% reduction in canopy from the 2030 baseline scenario. It is reflecting 2018 tree canopy, drought tolerant map. It is not a spatially explicit event.

In the upper bound map [27], there is 9% additional mortality from the 2030 baseline scenario, which is pretty bad. How do we adjust to the drought scenario?

In the table [28], we are representing the worst performers (species) in lower bound and upper bound. Pin Oak and Littleleaf Linden are common species in Cambridge. In both cases Hemlock does poorly. Red maple, Crabapple, Cherry are notable for higher losses in the more severe (upper bound) event.

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TF: What is the difference between American hornbeam and hornbeam?
Response: We need to check that, it might be a question of genus vs species. Trees in the data set that can't be classified down to the species level are listed by their genus.

TF: This is applied on to the baseline scenario. We see the impact of pests and diseases plus the drought?
Response: Yes, we're looking at what is the potential large scale impacts of these stressors.

We are not presenting the results for the flooding this month as we're still finalizing the conclusions. We're modeling a 100 year 24 hour event in 2030, and this map shows flood depths for the event. As you can see, one third of Cambridge is in Mystic River watershed, and other two thirds is in Charles River watershed. Flood intolerant trees will be removed from the lower bound scenario. Flooding impacts will be spatial (location specific) unlike the pest, disease, and drought impacts.

We have been told for 25 years that the canopy is declining in the Northern Forest, they have been measuring it and this is not a prediction. This is 'do nothing' scenario. These are what we intuitively knew. Think about how many cities in northern are not doing anything. This defines the leadership problem for us.

Response Strategies

This slide [31] is just the summary of where we left off in September. Today, Cambridge has 25.3% of its land area covered by canopy. Cambridge has had an average net loss of 31 acres of canopy cover every year. At this rate, canopy cover will be 16.2% in 2030. Factoring in climate change, it may be 10.5% in 2030 but with a moderate drought, it could be 9.5%.

How do we respond to this?
Stem the loss of existing trees and **Grow the canopy** by planting new trees. These are the two choices for how to spend our time and energy.

To put the decline that we've been looking at in a larger context, here's a graph [33] of forest cover and population change in New England which shows us that there is a dip in mid 1800s as the clearing of forest for farmland peaks. There's a secondary forest decline after the 1950s as the

suburbs spread out into wooded areas.

We've annotated the next graphic from UVM's 2012 canopy study, we call it the champagne diagram. It shows the percent of existing canopy by property (residential, single family) and when that property was constructed. Properties with homes built around 1920 have unusually high percentage of tree canopy. These trees are now likely reaching maturity. Development tapered off after 1930 so we can surmise that the residential canopy will also begin to taper off as those trees age. Incredible bursts of planting between 1850-1930. The bars at the top represent a hypothetical tree with a hundred year lifespan to help illustrate the canopy decline that results from the tapering off of residential construction.

TF: It's interesting to note the decline of tree planting in relation to the rise of air conditioning.

RH: That's a good point. Another correlation is the rise of residential development with strong tree canopy after 1870 which was the time of the City Beautiful movement and the creation of parks nationwide, arbor day was started in 1872. It is useful to think what is happening now in the culture, social dimension, how we situate our project culturally.

In thinking about growing the City's canopy, we were also intrigued by the parallel with retirement investing. This is about growing canopy, when do you start growing canopy. As starting to invest a small amount earlier accumulates in time, the same is true for tree plantings and canopy growth.

For a mortality rate of 6.5% a year, that is the curve you get. The table shows year over year canopy growth and the remaining canopy from 2018. When you plant 2,500 trees a year, you still are fighting against the time. But if you stem the loss to 3% a year, you overcome the loss. This is not only the city trees, but citywide. If you plant 5,000 annually for the first 5 years, and continue planting 2,500 trees a year, you would get a canopy gain. Maturation of the trees and climate change impact is huge, whether this is realistic or not.

Strategy Matrix:
Here is the decision framework [40] which we've reviewed previously. We are using this framework to structure a matrix of strategies [41]. In the strategy matrix, we have policy, planning, practice and outreach across the

top. We have a set of goals on the left side and a couple of categories. Within the strategies, we are going to walk you through a couple of these. As we go down, it focuses on specific conditions or areas. We're focusing on planning and design today. Policy and practices will follow.

Neighborhood Case Study:
This is a case study about how you start to act. The Wellington-Harrington neighborhood has overall 16.9% canopy cover and R.O.W. has 29.3% canopy cover. In this study we started to plant new trees on all the streets with sidewalks with 6' width or greater. This allows us to plant 645 trees (with 30' spacing between trees). After 20 years we have 38% canopy cover on R.O.W. but the overall canopy cover of the neighborhood only increases to 20% (assuming new trees have 20' diameter canopy after 20 years). This exercise allows us to see the limitations of relying on City plantings alone.

Looking at where else tree could be planted beyond City- owned property, "plantable areas" are overlaid on to this map [45]. Plantable area does not include buildings and sports fields but parking lots are included. Light green shows the existing canopy and dark green shows the plantable areas.

In terms of land use [46], most of the area is residential. To increase the overall canopy cover more, we need to plant in residential yards, commercial areas etc. If there are opportunities, they may be small opportunities but we are just trying to recognize, if there are limitations on ROW, what are the other ways to plant? Privately developed open spaces can be plantable with policy change but not the densely used areas. Another strategy is to create asymmetrical streets with new plantings.

Where are the plantable areas in the city? Citywide, the opportunities for planting are greatest on residential and open space land use types.

Streetscape Design:

We are trying to catalogue some of the conditions and strategies. City can look into these and decide where to plant.

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Typical narrow commercial streets
Parking or one lane may be taken out from some of the streets.

Major commercial avenues
Asymmetrical streets or boulevard streets. Taking the parking off the street.

Parking lots
There are quite a lot of surface parking lots. Some of these can be planted.

We had an interesting conversation with our ecological consultants, AES, thinking about an ecological approach to planting in cities. This graphic [56] shows the difference in tree coverage in a forest and savanna. In terms of canopy cover and tree spacing, the city is more like a savanna than a forest. But urban trees are generally forest species, used to growing in those conditions. There might be some opportunity here to rethink how we design urban plantings to better align planting conditions with those of a forest, such as grouping trees, not standard spacing, multiple stories of vegetation. These plant groupings might help stem loss and increase the vitality of the individual trees.

Planning Synergies

Where do you plant to enhance shading and cooling? We set up a category to focus on aligning our work with Envision Cambridge and CCPR work.

These are Envision plans [59,60] for an open space network and showing major corridors.

This map [61] show the existing and proposed biking network from the Cambridge City Bike Plan. Senseable City Lab also has the data on most used running, cycling and walking routes in the city [62-64].

We sketched out an initial concept that overlays all these plans to create a network of green corridors that link squares, transportation networks and open spaces. Primary bike routes, bus routes, bus stops, open spaces, primary and secondary set of streets, arteries, along the waterfront participate in this network. This helps us to plan where to prioritize plantings to build off the work of these other planning efforts.

We've also been working with the CCPR team to develop a tree planting

detail that incorporates stormwater storage.

Owen: Bike lane on western avenue is porous. Overflows to catch basin. The trees are thriving.

New treatment of stormwater that also addresses urban heat island.

TF Comments:
TF: There is a permeable pavement that goes along the street, in Boylston in Boston, trees are doing well.

Not small proposition, a strategy to grow health trees over time.

TF: Alewife area, rapid development, it will be all constructed before we finish our meetings. How can we have an impact?
Response: We can significantly improve it by proposing green infrastructure and canopy build out.
TF: There is no rules or structures for the development to plant trees.

TF: Envision team is looking to Alewife, the goal toward zoning, thinking about shade and open spaces. We can help them with language, what we are advocating.

TF: There is a top down approach in the city, it is about communities, climate change perspective, how can we communicate this with people?

TF: City needs to demonstrate leadership. “We plant well”, “we are the model”, set the example for what people need to do.

TF: But there’s a problem in the City of depending on top-down thinking to solve problems. We should be developing an understanding within communities of the need to combat climate change, a culture of climate care.

TF: We should cultivate ambassadors, identify who in the City are themselves cultivators.

TF: Particular education tools, who do they appeal to? Recommendation to the city, middle school kids need to be learning these etc.

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TF: Pilot project, a stretch of Mass Ave, designed by RH ?
Response: Western Ave recent construction demonstrated new strategies.

TF: All the stormwater, ripping up the sidewalks, what it means for the neighborhood. East Cambridge dense neighborhood, so tiny open space, it is valuable to this effort.

TF: Yards are being infilled, not planted anymore, new condos and housing. Creating plantable space. A lot of asphalt in people's yards, how can we get it planted?
Response: It is about incentive building

TF: The strategy matrix could be simplified, boil it down, reduce loss, increase gain. Some categories or strategies in matrix are repetitive.

Public Comment Period:

Speaker 1: City Councilor who advocated for the creation of the Urban Forest Master Plan. Thank you for the amazing work. I read today about the ongoing biomass loss of insects worldwide. Goals from Envision, urban form didn't include the trees. Setting the context,
I met with a property owner who was proposing to cut down a tree for a new curb cut. He didn't know the 20% loss that we are having. How do we get more people to understand this? A complicated system, it is hard to predict. We need to do "safe to fail" experiments. City has done some great experiments, biochar for instance. If it turns out that it doesn't help the trees, it doesn't kill the tree either.

Speaker 2: Sarah Bell, Russell Aprtements, elderly house on Mass ave, being renovated. The city should use it as an example as a green space. Pilot projects on city property. Blockwide, we need to invest in green spaces. There needs to be a model, businesses with green and trees.
Leading is important, change in the strategy of the city.
How much of the canopy is on ROW?
Response: 20% on ROW, 40-50% on residential

Speaker 3: Question about the number of trees needed to be planted, and

the loss rate? Previously you had showed that we need to plant 4300 trees just to keep up with loss and then 5600 trees to get 1% new canopy cover, and now you're showing 5000 trees?
Response: Yes, the 3400 and 5600 numbers from the last presentation were an exercise to understand how many trees would be needed to stem loss and create 1% canopy cover but they were not specific proposals.

Speaker 4: Thank you, I learn a lot each time. We're attracting new businesses which in turn requires denser residential development. How do we balance the pressures aligned against creating/reserving space for trees?

Speaker 5: In Alewife we have giant blocks, light industrial with large trucks, flood prone area, not a lot of room for trees. What is the target canopy cover?

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