From: [redacted]
To: [redacted] myerscough.ac.uk; [redacted]
Cc: [redacted] lbhf.gov.uk
Subject: London public realm trees climate vulnerability assessment study
Attachments: GOAL 1_Commissioned Research GLA UPL-CR0001_with AJ comments.pdf

---

Dear [redacted] dear [redacted]

Thank you very much for coming back so quickly on your availability to meet.

I attach some initial feedback for you to consider. I have circulated your draft proposal to the LTOA chair and deputy chair (both CCd), to my GLA colleagues from the Climate Adaptation team, and to some manager in our Green infrastructure unit ([redacted] and [redacted]). They might provide additional feedback to mine, which I will forward in due course.

Please find below a proposed agenda. Feel free to suggest amendments. I am happy to chair.

12.00 Introductions

12.05 Study scope

How do we address time horizons, tree profiles (e.g. street trees vs parks trees), UHI gradient/zones, tree management

12.20 Data needs

What data will be needed? What are concerns on data quality?

12.35 Governance and stakeholders' input

Steering group composition, stakeholders to be involved (and who manages their involvement)

12.45 Costs, delivery timescales and invoicing

12.55 Next steps

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Passcode: xx7Z6hZ9

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Phone conference ID: 783 486 62#

For organizers: Meeting options <https://teams.microsoft.com/meetingOptions/?organizerId=5919e3b6-ee0f-4e6d-9fd7-e27b6974ff75&tenantId=30653dea-fb01-4b4c-8ddf-c183f89febfb&threadId=19_meeting_NmQ1NmJiZmYtZDI0Yy00MjI4LThjNmMtY2U2Yjc2ODdjNWI5@thread.v2&messageId=0&language=en-US> | Reset dial-in PIN <https://dialin.teams.microsoft.com/usp/pstnconferencing>

Welcome to the GLA's Team's Meeting

URBAN PLANT LAB

Commissioned Research Proposal – Greater London Authority
20th November 2024

Urban Plant Lab is a not-for-profit organisation that provides a 'centre of gravity' for plant selection research and knowledge exchange. Drawing on a range of expertise from the international research community and leading practitioners to deliver the best in contemporary, evidence-based guidance on plant use in urban environments.

Shared vision

London's urban forest contributes to the wellbeing of residents and visitors in manifold ways. Whilst as a whole, London's urban forest is taxonomically rich, relatively few species dominate. To support an agenda of strategic diversification, it is critical to evaluate the vulnerability of London's trees to a changing climate. Using contemporary analysis, Urban Plant Lab will report on the likely resilience of London's trees to future climate scenarios.

Project Overview

Using collated tree inventories from local authorities within the Greater London Authority area, species representing greater than 2% or more of the species composition will be evaluated for their likely resilience to the SSP3 climate scenario.

Objectives

The project will:

- Determine the resilience of London's urban tree species to a future climate scenario.

Project Team

[redacted]

URBAN PLANT LAB

[redacted]

Management and Collaboration

The project will be jointly managed by [redacted] and [redacted] To help ensure that the project meets stakeholder objectives, quarterly meetings will be held with the GLA project lead – [redacted] Two interim project meetings with representation from a wider range of stakeholders will take place to share ideas, experience and expertise.

Urban Plant Lab reserve the right to bring in additional partners to bolster the impact and relevance of this project. However, all contributions to funding and expertise will be fairly acknowledged.

Programme of Work

- Work package 1 – *Collate and consolidate GLA tree inventory to determine species list for further analysis* (Lead – AH)
    - Task 1.1: GLA to provide tree inventories in an agreed format (.csv) to enable the project team to unite databases and draft species list for further analysis.
    - Task 1.2: GLA Tree demographic analysis presented to stakeholder group for confirmation of species subjected to resilience modelling.
- Work package 2 – *Tree resilience to future climate scenarios* (Lead – KM)
    - Task 2.1: Review and select the most appropriate methodologies to develop tree resilience rating.
    - Task 2.2: Develop analytical frameworks for the consistent evaluation of tree species resilience to future climate scenarios within London.
    - Task 2.3: Develop a composite resilience scoring system that is intuitive to non-specialists.
- Work package 3 – *Future species for London's urban forest* (Lead – HS)
    - Task 3.1: Develop a list of functionally similar species for those found to have low resilience to future climate scenarios.
    - Task 3.2: Identify supply chain constraints for recommended future species
- Work package 4 – *Reporting* (Lead AH)
    - Task 4.1: Written report submitted to GLA with key findings and outcomes.
    - Task 4.2: Workshop (hosted by GLA) with project team to discuss how project findings could be integrated into relevant strategies and policy. (optional, event cost not included in the research budget)

URBAN PLANT LAB

Outcomes

The major outcome of this project will be a report to GLA identifying the species with greatest resilience to London's projected climate.

Risk Management

It should be acknowledged that this project has novelty and as such may face unforeseen challenges to the achievement of objectives. However, fundamentally this project seeks apply proven analytical approaches to the strategic challenges facing London's urban forest. The context is novel, but the methodology is mature, thus we deem the project to be highly achievable.

The project team has a wide range of skills and proven expertise in their fields. Therefore, we are confident that objectives and deliverables can be achieved.

The greatest risk is the quality of the initial tree inventories supplied by the relevant authorities operating within the region of interest (London). If data is not collected in systematically, developing a representative species list could be challenging.

Requested funding

£15,000

URBAN PLANT LAB

References and selected publications from the Urban Plant Lab team

Hirons, A.D. and Sjöman, H. (2018) Tree Species Selection for Green Infrastructure: A Guide for Specifiers. Trees & Design Action Group.

Hirons, A. and Thomas, P.A. (2018) *Applied Tree Biology*. John Wiley & Sons.

Hirons, A.D., Watkins, J.H.R., Baxter, T.J., Miesbauer, J.W., Male-Muñoz, A., Martin, K.W.E., Bassuk, N.L. and Sjöman, H. (2020) Using botanic gardens and arboreta to help identify urban trees for the future. *Plants, People, Planet*. https://doi.org/10.1002/ppp3.10162

Sjöman, H. and Watkins, J.H.R. (2020) What do we know about the origin of our urban trees?–A north European perspective. *Urban Forestry & Urban Greening*, *56*, p.126879.

Sjöman, H., Hirons, A.D. and Bassuk, N.L. (2015) Urban forest resilience through tree selection—Variation in drought tolerance in Acer. Urban Forestry & Urban Greening, 14(4), pp.858-865.

Sjöman, H., Hirons, A.D. and Bassuk, N.L. (2018) Improving confidence in tree species selection for challenging urban sites: a role for leaf turgor loss. *Urban Ecosystems*, *21*(6), pp.1171-1188.

Sjöman, H., Hirons, A.D. and Bassuk, N.L. (2018) Magnolias as urban trees – a preliminary evaluation of drought tolerance in seven magnolia species. Arboricultural Journal. (40)1-10.

Sjöman, H., Hirons, A.D. and Deak Sjöman, J. (2017) Criteria in the selection of urban trees for temperate urban environments. *In:* Ferrini, F., Van Den Bosch, C.C.K. and Fini, A. () Routledge Handbook of Urban Forestry. Taylor & Francis. pp 339-362.

Sjöman, H. and Anderson, A. (2023) The Essential Tree Selection Guide: for Climate Resilience, Carbon Storage, Species Diversity and Other Ecosystem Benefits. Filbert Press

Sjöman, H., Ignell, S. and Hirons, A. (2023) Selection of shrubs for urban environments—An evaluation of drought tolerance of 120 species and cultivars. *HortScience*, *58*(5), pp.573-579.

Watkins, H., Hirons, A.D., Sjöman, H., Cameron, R. and Hitchmough, J.D. (2021) Can trait-based schemes be used to select species in urban forestry? Frontiers in Sustainable Cities, 3, p.21.

From: [redacted]
To:
Subject: 7 Feb event prep & catch-up on resilience study

_____
Microsoft Teams meeting Need help? <https://aka.ms/JoinTeamsMeeting?omkt=en-GB>
Join: https://teams.microsoft.com/meet/384719376724?p=uFfxcR6qgiI8qE1B6h <https://teams.microsoft.com/l/meetup-join/19%3ameeting_OTk3OTYzMjgtMzYxYS00ZjRiLWE1OTYtODM4NTY5YWVlNmM3%40thread.v2/0?context=%7b%22Tid%22%3a%2230653dea-fb01-4b4c-8ddf-c183f89febfb%22%2c%22Oid%22%3a%225919e3b6-ee0f-4e6d-9fd7-e27b6974ff75%22%7d>
Meeting ID: 384 719 376 724
Passcode: Jk6SF334
_____

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Find a local number <https://dialin.teams.microsoft.com/5f0d4234-6a2c-406b-92e8-a05173c676c7?id=788948970>
Phone conference ID: 788 948 970#
For organisers: Meeting options <https://teams.microsoft.com/meetingOptions/?organizerId=5919e3b6-ee0f-4e6d-9fd7-e27b6974ff75&tenantId=30653dea-fb01-4b4c-8ddf-c183f89febfb&threadId=19_meeting_OTk3OTYzMjgtMzYxYS00ZjRiLWE1OTYtODM4NTY5YWVlNmM3@thread.v2&messageId=0&language=en-GB> | Reset dial-in PIN <https://dialin.teams.microsoft.com/usp/pstnconferencing>
Welcome to the GLA's Team's Meeting
_____

From: [redacted]
To: [redacted]
Cc:
Subject: RE: Query regarding number of trees in London / Next steps for assessment of the climate resilience of London"s public realm trees
Date: 24 April 2025 22:25:40
Attachments: image002.png
image003.png

Hi [redacted]
Thanks, that is really useful feedback.
Briefly, I think that we should be able to infer something based on the iTree tree data. [redacted] and I have already been in touch and he sent some key data to me from Appendix II. We are on the same wavelength there I think.
Of course we will happily provide more justification on the methods. It really was the compressed timescale of the interim report that meant that it was very scant from that point of view. However, there is a robust literature and rationale for the traits we have included. For sure, we will elaborate this in the final report.
[redacted] could no doubt elaborate further, but the BGCI CAT tool that TreeEconomics used basically only uses temperature as a variable, the modelling that [redacted] is pioneering also includes a climatic moisture index that greatly improves the model by capturing more of the 'tree's experience'. Further, we believe that combining the modelling with the trait data also provides a more robust approach. None of these metrics are perfect but they all bring something to the table. The BGCI tool is currently being rewritten because of the limitations that the original version used in the TreeEconomics report. Read into that what you will.
It looks like the TreeEconomics report only looked at the top ten species, however, we are doing about 40. It was great to see that the TreeEconomics report looks into the biotic threats to London's trees. That is beyond the scope of the Urban Plant Lab report, however, if you and key stakeholders still believe this pest and pathogen evaluation represents the state of current knowledge, we could look to tie some of it in. I am on a working group in a FR project that is looking at this question as well.
Yes, I should have mentioned in the report that we will provide a 'high confidence' and 'low confidence' statement around the main outcome statement, so that we are as transparent as possible about our evaluation. This was already in my thinking – in fact [redacted] and I were discussing this earlier today, before I picked up this email
Framing and interpretation. Yes, I think regular dialogue with you will help, once we have conducted the basic underpinning analysis. Basically, I fully agree with your comments.
The full report will include inner and outer sites. The interim was just based on inner London.
[redacted] and I have already discussed opportunities for geospatial visualisation. We are actively thinking about this and will keep you posted.
The next few weeks I will have to dedicate to marking – the day job takes over at this time of year. I am on a research project in the Morton Arboretum most of July and then on leave for the first part of August.
If you would like a workshop this side of the summer, I suggest that we look at the last two weeks in June. Otherwise, it will have to be September. Let's chat about the invite list.
Can I just check that we have all the data now, or are there other boroughs that need to contribute?
I hope this brief response helps,
Kind regards,

[redacted]
Senior Lecturer in Arboriculture and Urban Forestry
University Centre Myerscough
Bilsborrow, Preston, Lancashire, PR3 0RY
Tel: [redacted]
Web: http://www.myerscough.ac.uk/

From: [redacted]
Sent: 24 April 2025 17:20
To: [redacted] ; [redacted]
Cc: [redacted] ; [redacted]
Subject: RE: Query regarding number of trees in London / Next steps for assessment of the climate resilience of London's public realm trees

Hi [redacted]
The database you analysed only included **public realm trees**.
The iTree Eco study, which is sample based, assessed the whole London urban forest, including trees in private ownership. As in most urban areas, the latter represent the lion's share of the local tree population (about 60%). I believe all species identified in the iTreeEco study as representing more than 1% of the total population (based on the sample-based approach used – see Appendix II in the full iTreeEco report) are represented in your list (Table 1 of your report), except Cupressus spp, Cupressocyparis leylandii, Chamaecyparis spp, (ie. private hedges!), plus Castanea spp and Ulmus spp.
I wonder if the iTree Eco study findings could be valuable in helping us interpret the significance of your findings for the whole of the London urban forest, using the dominance figures (species abundance X % of leaf area)?
Regarding your Interim report, [redacted] and I had the following observations/questions.
1/ Do you think you could explain a little bit more about your methodology, and specifically why you chose those three plant traits (wood density, leaf dry matter content and turgor loss point) to inform your analysis alongside the species distributions records based on mean

annual temperatures?
I would like your report to convey more clearly why your approach differs and is possibly more reliable than that used in the *London Urban Forest Resilience Research Report* Treeconomics produced using the CAT model. We've specifically been asked by members of the London Assembly sitting on the Environment Committee why we were undertaking this follow-on work from the Treeconomics report. I have provided some simple answers to this (around accounting for water needs & water availability) but would look forward to some more precise explanations of why you chose the indicators named above. I appreciate this will take us into quite a technical territory of tree biology, but I still believe it's important we have access to your rationale (and hope you can convey it is relatively accessible terms for those of us -including myself!- who are not expert in tree biology!!). I think this is important to document also in light of the aspirations that are placed upon the urban forest in terms of cooling potential – and understanding trade-offs between resilience & evapotranspirative cooling (or what it would take if in some places, we want to have both).
2/ How can you convey the level of certainty or the margin for error in the results? it would be good to quantify to what extent the limitations referenced in the report could impact the headline figures.
3/ Framing and interpretation: As presented, the sobering figures you have identified could lead to some misinterpretation on the role of species diversification: taken at face value, it could be read that there are 3 species we should be focussing on. As the next stage of the report develops, do you think you could include a 'discussion/implications' section placing the findings more clearly in the context of other factors relevant to species choice (to avoid misinterpretation)? Such 'discussion/interpretation' section might also be a good opportunity to raise the issues associated with the above-mentioned trade-offs between drought resilience and cooling potential, as well as consider potential impacts of your findings on canopy cover resilience at a pan London scale using the dominance figures from the ITreeEco study, etc??
4/ Inner vs Outer London (UHI) – task 2.2: We had discussed differentiating between inner and outer London to account for the impact of the UHI effect (task 2.2 in your proposal)? What is your timeframe to work on this?
5/ Spatial representation: we're interested in exploring whether we can represent your findings spatially now by applying the data to the London Tree Map (and therefore identify geographical areas of heightened vulnerability). I appreciate this wasn't in your initial brief. Is this something you could undertake, and if so, what would it take? We will likely also explore this with GiGL.
6/ Approx timeline for tasks 3 and 4.2: What is your timeframe to put forward the list of alternative species (task 3)? When would you like to aim to have the workshop, and do you have some thoughts on who you would want to see attending?
Please do not feel that you need to produce a revised report in light of these, as I would like to also gather comments from a few key other stakeholders (from FC and the LTOA notably) before you invest time into the next report iteration. I would however welcome an email response when you can!
In terms of a revised report, I was thinking we could have 1 additional iteration before the workshop, capturing points 1-4 above, and including the outputs from task 3 of your proposal (ie. the alternative species list) – so that all workshop attendees would have the opportunity to read your analysis and its interpretation before the event.
Following the event you would produce the final version, including management recommendations/implications stemming from the workshop discussions. This would be subject to one round of comments. Would this approach work for you?
Best,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are:[redacted]

From: [redacted] <[redacted]myerscough.ac.uk>
Sent: Monday, April 14, 2025 1:16 PM
To: [redacted] <[redacted]london.gov.uk>; [redacted] <[redacted]gigl.org.uk>
Subject: Query regarding number of trees in London

Hi [redacted] and [redacted]
I was just rereading the London iTree report and came across this:

How accurate do you think this is? And, if accurate are we missing between 6 and 7 million trees from our analysis?
Thoughts welcome.

[redacted]
University Centre Myerscough,
Bilsborrow,
Preston,
Lancashire, PR3 0RY
UK
Tel:[redacted]

From: [redacted]
To: [redacted]
Cc: [redacted] RBKC; [redacted] H&F
Subject: Re: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London"s Public Realm Trees
Date: 03 June 2025 08:24:55
Attachments: image001.jpg

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Hi there,

[redacted], but I think something early afternoon on the Tuesday for you - first thing in the morning for me - would work okay.

Potentially similar times on the Wednesday or Thursday, but there are scheduled activities that might interfere…. Tuesday would be best I think.

Thanks,

[redacted]

Sent from Outlook for iOS

From: [redacted]
Sent: Tuesday, June 3, 2025 8:09:21 AM
To: [redacted]
Cc: [redacted] RBKC ; [redacted] H&F
Subject: Re: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees

Hi [redacted]

All the dates and time work for me at the moment.

Kind regards

[redacted]

From: [redacted]
Sent: 02 June 2025 18:46
To: [redacted]
Cc: [redacted] RBKC ; [redacted] H&F
Subject: RE: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees

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Report this email as Suspicious via Kew Service Desk

Dear [redacted]

A big thank you for coordinating this feedback.

My availability on the week starting on 9 June is as follow:

- Monday 9 June: before 14.30
- Tuesday 10 June: 11.00 or sometime between 13.00 and 15.00

- Wednesday 11 June: 10.00 or 12.00
- Friday 13 June: anytime before 16.30

[redacted] would any of these times work for you?
Obviously, anyone else on this email is welcome to attend – but at a minimum we need either [redacted] or [redacted] and [redacted] plus me if possible!
Kind regards,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: Friday, May 30, 2025 7:02 PM
To: [redacted]
Cc: [redacted] ; [redacted] ; [redacted] ; [redacted] ; [redacted] ; [redacted] ; [redacted] RBKC ; [redacted] ; [redacted] H&F
Subject: RE: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees

Official

Dear [redacted]
I hope that you are well.
Thanks again for including the LTOA in this discussion and giving us the opportunity to provide feedback.
Please see the collated notes in response to the shared information as attached. We've decided to present in bullet points under appropriate headings; there would be a benefit to having a discussion to compliment the notes, is this something that we could arrange for the week commencing 9th June?
Kind regards

[redacted]
Arboricultural Manager
Serving Richmond and Wandsworth Councils
Tel: 020[redacted]
Email: [redacted]richmondandwandsworth.gov.uk
www.richmond.gov.uk / www.wandsworth.gov.uk
Please note that my weekly working pattern is Monday-Tuesday and Thursday-Friday

---

From: [redacted] <[redacted]london.gov.uk>
Sent: 16 May 2025 12:51
To: [redacted] RBKC <[redacted]rbkc.gov.uk>; [redacted] <[redacted]ealing.gov.uk>;

[redacted] [redacted] H&F <[redacted]lbhf.gov.uk>; [redacted] [redacted] <[redacted]richmondandwandsworth.gov.uk>
Cc: [redacted] [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] [redacted] <[redacted]london.gov.uk>; [redacted] [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] [redacted] <[redacted]kew.org>; [redacted] [redacted] <[redacted]myerscough.ac.uk>
Subject: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees
Importance: High

Dear [redacted] and [redacted]

Please **DO NOT circulate** the attached Draft Interim Report prior to seeking my consent**.**

Please send your feedback/comments to me **by 30 May**, considering the **6 points** highlighted below. Some further **context** is also provided.

Finally, [redacted] Welcome here! Please find out more about why you are receiving this under **Welcome** [redacted]

Context:

As mentioned above, please attached an early draft of the Interim Report [redacted] and [redacted] have prepared to present some initial findings from their assessment of the climate resilience of London's public realm trees.

I would like to keep the distribution list of this draft very limited. The framing and contextual information needed to avoid risks of misinterpretation is not included in this report. Be warned: the findings presented are sobering. Please keep in mind that these findings are only applicable to inner London (ie. higher Urban Heat Island intensity). Outer London figures will feature in the next (and final) iteration of this Interim report.

The final Interim Report will be circulated (only) among those attending the workshop we plan on having in late June, to discuss the implications of these findings on tree and supply chain management.

The full Final Report will capture the recommended next steps/implications identified during the workshop. Only this final report will be released in the public domain (more on this further below).

Please share your questions and feedback on this report with me by COB on 30 May. I propose we hold an online steering committee meeting the week after (exact date tbc).

Before drafting your feedback on this report, please note:

1. **Method statement**: a more detailed explanation of the methodology used to conduct the assessment will be included in the next iteration of the report. This will address how the approach taken is designed to provide more accurate results than the climate resilience assessment delivered in Treeconomics 2014 report. It will emphasise the importance of the use of the Climatic Moisture Index. It will also explain why the three plant traits used were selected and used to inform the analysis.
2. **Error margin**: [redacted] and [redacted] are planning to provide a 'high confidence' and 'low confidence' statement around the main outcome statement, so as to be as transparent as possible about their evaluation.
3. **Geospatial analysis and visualisation**: I have pointed out the mapping findings / exploring geographical clusters of vulnerability would be really valuable – something that [redacted] and [redacted] were already exploring. Depending on what they can deliver within the scope of this study, I might seek support on this from GiGL and/or the GLA GIS team to get some analysis done. In any case, I would want your input on the brief for such mapping/geospatial analysis exercise.
   As part of the release of the study, I am planning to get [redacted] resilience score added to the London Public Realm Tree map – and ensure the functionalities of this map are enhanced so that, one can filter based on tree location types (eg 'street trees', 'Parks and Open Space tree', 'Other location') and/or based on resilience score.
4. **Discussion**: a discussion section will be included in the next iteration of the report, helping to

frame and interpret results. Without such framing, results could be really mis-interpreted (ie one could conclude that in inner London, one should only plant 3 species).

5. **List of alternative species:** Forthcoming.
6. **Launch and Coms plan**: As you might be aware, yesterday's London Assembly Environment Committee meeting explored the topic of 'Trees in a Changing Climate'. If you have a long journey coming up offering a 'window of time', it is work listening to the recording. The Committee session, made the Evening Standard the next day, and the BBC's online news this morning. This confirms how much interest there is around this topic. I would like the London Urban Forest Partnership as a whole, and the partners leading on steering this study in particular, to have a robust, shared communication plan (with clear messages on Next Steps) ready for September when we release [redacted] and [redacted] findings.

Last, but not least: Welcome [redacted]

I am adding [redacted] to this distribution list, given his recent contribution to the Environment Committee.

[redacted] welcome to the (rather informal) steering committee for the London Public Realm Trees Climate Resilience study [redacted] [redacted] and [redacted] [redacted] are preparing for the London Urban Forest Partnership (GLA and FC are funding this work). For your information, I also attach the agreed scope of work for this project.

Thank you all for your time on this.

Kind regards,

[redacted]
[redacted] [redacted]
London Urban Forest Plan Coordinator
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted] london.gov.uk
My pronouns are: [redacted]

From: [redacted]
To: [redacted] RBKC; [redacted]
Cc: [redacted]
Subject: RE: Feedback on draft Interim climate resilience report & workshop planning
Date: 09 June 2025 10:54:56
Attachments: image001.jpg

Dear [redacted]
This wouldn't leave enough time for [redacted] and [redacted] to incorporate your feedback into the Interim report.
I propose we keep the session scheduled for Friday 13. [redacted] is available to attend and with a bit of luck, [redacted] will also be able to join. I trust [redacted] can relay LTOA questions & comments. Any additional feedback you may have can still be shared during the workshop!
In my eyes, the goal of this feedback session is two-fold:
1/ Provide some feedback on the draft Interim report, so that [redacted] and [redacted] can use this feedback to finalise the Interim Report that will be circulated on Friday 20 June, ahead of the workshop on Tuesday 24 June.
The final report (due in September) will capture implication of the findings as discussed during the workshop, and will provide the opportunity to integrate/reflect (within the realm of possible given the resources allocated to this work) relevant other feedback received.
2/ Plan the 24 June workshop.
If you wanted to touch base with me ahead of the 24, I would be happy to do that and have time to do so.
Kind regards,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted] london.gov.uk
My pronouns are: [redacted]

From: [redacted] RBKC
Sent: Monday, June 9, 2025 9:42 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Feedback on draft Interim climate resilience report & workshop planning

Can we push this to next Friday (20th) please?
Kind regards
[redacted] FdSc MArborA
Arboricultural Officer | Planning and Place

Royal Borough of Kensington and Chelsea
Kensington Town Hall, Hornton Street, London, W8 7NX | Tel: 020 7361 [redacted]

Our Values - Putting Communities First | Respect | Integrity | Working Together
If you would like to comment about the service that you have received please click here and complete our quick survey.
Have you signed up to our email notifications to receive alerts of relevant applications received by this department? If you would like to sign up, please click the following link https://www.rbkc.gov.uk/myrbkc/Login.aspx
Fast track services for planning applications are now available. More information can be found here - Fast Track Application Service | Royal Borough of Kensington and Chelsea (rbkc.gov.uk)

From: [redacted] myerscough.ac.uk>
Sent: 09 June 2025 05:32
To: [redacted] london.gov.uk>; [redacted] kew.org>; [redacted] richmondandwandsworth.gov.uk>
Cc: [redacted] RBKC rbkc.gov.uk>; [redacted] forestrycommission.gov.uk>; [redacted] @forestrycommission.gov.uk>; [redacted] london.gov.uk>
Subject: Re: Feedback on draft Interim climate resilience report & workshop planning

> You don't often get email from [redacted] myerscough.ac.uk. Learn why this is important

Hi [redacted]
[redacted] If I can, I will be there.
Thanks,

[redacted]
Sent from Outlook for iOS

From: [redacted] london.gov.uk>
Sent: Friday, June 6, 2025 10:01:30 AM
To: [redacted] kew.org>; [redacted] myerscough.ac.uk>; [redacted] richmondandwandsworth.gov.uk>
Cc: [redacted] RBKC rbkc.gov.uk>; [redacted] forestrycommission.gov.uk>; [redacted] @forestrycommission.gov.uk>; [redacted] london.gov.uk>
Subject: Feedback on draft Interim climate resilience report & workshop planning
When: Friday, 13 June 2025 13:00-13:55.
Where: Microsoft Teams Meeting

Dear all: [redacted] is only available on Friday for this. [redacted] does this new proposed time work for you?
I will circulate some initial thoughts on the workshop by the end of the week. Hackney has offered to host at one of its GLL venues in the marshes – they are currently double-checking venue availability. The Hackney Tree Musketeers community tree nursery is just nearby and Marcelo White, one of the nursery managers could give us a tour (offering an opportunity to take a break while also looking at the potential associated with non-commercial

nurseries to augment what commercial nurseries can provide).
As a fall back, Islington Council would be able to host.
13 guests have currently accepted our invitation, as follow:

Organisation	First name	Surname	RSVP	Job Title
DEFRA	[redacted]		Declined	[redacted]
University of Birmingham			Declined	
Barcham			Declined	
University of Birmingham			Declined	
Oxleas Tree Contractor			Declined	
Hillier			Accepted	
London Borough of Southwark			Accepted	
Myerscough (and Urban Plant Lab)			Accepted	
Royal Botanical Gardens, Kew (And Urban Plant Lab)			Accepted	
London Borough of Islington			Accepted	
Oxleas Tree Contractor			Accepted	
Forest Research			Accepted	
Forestry Commission			Accepted	
Greater London Authority			Accepted	
Greater London Authority			Accepted	
Forestry Commission			Accepted	
London Boroughs of Richmond and Wandsworth			Accepted	
Hackney Tree Musketeers and London Borough of Islington / Hackney Tree Musketeers			Accepted	
MHCLG				
DEFRA				
DEFRA				
DEFRA				
Hillier				
Thames Chase Trust				
Forestry Commission				
Forestry Commission				
Forestry Commission				
Royal Borough of Kensington and Chelsea				
London Borough of Hammersmith & Fulham				
London Tree Officers Association (also London Borough of Ealing Arboricultural Manager)				
Met Office				
The Street Tree				
Transport for London				
Majestic Trees				
Majestic Trees				
Barcham				

Declined	5
RSVP	13
No response	18

Microsoft Teams [Need help?]

[Join the meeting now]

Meeting ID: 381 684 306 818 0
Passcode: 94Sb7SG2

From: [redacted]
To: [redacted]
Cc: [redacted] RBKC; [redacted] H&F
Subject: Re: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London"s Public Realm Trees
Date: 13 June 2025 16:44:27
Attachments: image001.jpg

Thanks [redacted]

That's a really helpful summary. My flight was delayed so I was scrambling to rebook a connecting flight up to Manchester when the meeting was going on. Still at Heathrow, but I should get back this evening…

[redacted] and I have already been in touch and we will be having a follow up on Monday.

Have a good weekend,

[redacted]

Sent from Outlook for iOS

From: [redacted]
Sent: Friday, June 13, 2025 4:23:39 PM
To: [redacted]
Cc: [redacted] RBKC ; [redacted] H&F
Subject: RE: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees

Dear all,

Thank you for making time today. I capture below the actions stemming from our discussion.

[redacted] lead on six of the next steps identified, [redacted] on two, and I on three.

Please feel free to add/modify if I have missed or mis-represented anything.

Method statement:

1. [redacted] Provide a simple description of how each selected plant trait informs the understanding of climate resilience e.g *wood density tells us about/is a proxy indicator of/is a proxy indicator…., turgor loss point tells us about…*
2. [redacted] Better explain approach to deriving final resilience score from the combined use of plant traits data and observation data for different climate conditions.

Data collection

3. [redacted] Ensure that LTOA upcoming seminar and other LTOA communication channels are used to emphasise importance of data sharing effort / support pan-London public realm tree data collection efforts.
4. [redacted] Liaise with [redacted] on missing datasets/attributes to agree how best data request to LTOA members can be amplified by LTOA
5. [redacted] Feedback species naming issue to LTOA exec committee & explore using LTOA links w/ Eazytreev and Treeplotter to promote the introduction Plants of the World Online (POWO) as shared default naming standard built into tree management software used across London (would there be an option to also build this into Confirm?)

Geospatial visualisation & data-sharing

6. [redacted] Scope out for [redacted] what geospatial analysis UPL could provide to help inform

management decisions and associated cost.

7. [redacted] Identify what refencing system should be used to ensure the dataset produced can be made available, but is adequately referenced when such use occurs.

Report presentation & other actions on content:

8. [redacted] Place "Do Not Circulate" watermarks throughout the report.

9. [redacted] To have a section in the report explicitly identifying next steps required to reduce the uncertainty associated with the analysis (e.g. enhancing quality of species data in inventories, collecting/sourcing plant trait data for those species where such information is lacking, etc.)

[redacted]

24 June Workshop

11. [redacted] circulate workshop agenda for final sign-off by this group (will also include final list of attendees & proposed table allocation)

Many thanks again for your time today & have a good weekend,

[redacted]

Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: Friday, May 30, 2025 7:02 PM
To: [redacted]
Cc: [redacted] RBKC ; [redacted] H&F
Subject: RE: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees

Official

Dear [redacted]

I hope that you are well.

Thanks again for including the LTOA in this discussion and giving us the opportunity to provide feedback.

Please see the collated notes in response to the shared information as attached. We've decided to present in bullet points under appropriate headings; there would be a benefit to having a discussion to compliment the notes, is this something that we could arrange for the week commencing 9th June?

Kind regards

[redacted]

Arboricultural Manager
Serving Richmond and Wandsworth Councils
Tel: 020 [redacted]
Email: [redacted]richmondandwandsworth.gov.uk
www.richmond.gov.uk / www.wandsworth.gov.uk

Please note that my weekly working pattern is Monday-Tuesday and Thursday-Friday

From: [redacted] <[redacted]london.gov.uk>
Sent: 16 May 2025 12:51
To: [redacted] RBKC <[redacted]rbkc.gov.uk>; [redacted] <[redacted]ealing.gov.uk>; [redacted] H&F <[redacted]lbhf.gov.uk>; [redacted] <[redacted]richmondandwandsworth.gov.uk>
Cc: [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] <[redacted]london.gov.uk>; [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] <[redacted]forestrycommission.gov.uk>; [redacted] <[redacted]kew.org>; [redacted] <[redacted]myerscough.ac.uk>
Subject: IN CONFIDENCE: Early DRAFT of the Interim Report on the Climate Resilience of London's Public Realm Trees
Importance: High

Dear [redacted] and [redacted]

Please **DO NOT circulate** the attached Draft Interim Report prior to seeking my consent**.**

Please send your feedback/comments to me **by 30 May**, considering the **6 points** highlighted below. Some further **context** is also provided.

Finally, [redacted] Welcome here! Please find out more about why you are receiving this under **Welcome** [redacted]

Context:

As mentioned above, please attached an early draft of the Interim Report [redacted] and [redacted] have prepared to present some initial findings from their assessment of the climate resilience of London's public realm trees.

I would like to keep the distribution list of this draft very limited. The framing and contextual information needed to avoid risks of misinterpretation is not included in this report. Be warned: the findings presented are sobering. Please keep in mind that these findings are only applicable to inner London (ie. higher Urban Heat Island intensity). Outer London figures will feature in the next (and final) iteration of this Interim report.

The final Interim Report will be circulated (only) among those attending the workshop we plan on having in late June, to discuss the implications of these findings on tree and supply chain management.

The full Final Report will capture the recommended next steps/implications identified during the workshop. Only this final report will be released in the public domain (more on this further below).

Please share your questions and feedback on this report with me by COB on 30 May. I propose we hold an online steering committee meeting the week after (exact date tbc).

Before drafting your feedback on this report, please note:

1. **Method statement**: a more detailed explanation of the methodology used to conduct the assessment will be included in the next iteration of the report. This will address how the approach taken is designed to provide more accurate results than the climate resilience assessment delivered in Treeconomics 2014 report. It will emphasise the importance of the use of the Climatic Moisture Index. It will also explain why the three plant traits used were selected and used to inform the analysis.
2. **Error margin**: [redacted] and [redacted] are planning to provide a 'high confidence' and 'low confidence' statement around the main outcome statement, so as to be as transparent as possible about

their evaluation.

3. **Geospatial analysis and visualisation**: I have pointed out the mapping findings / exploring geographical clusters of vulnerability would be really valuable – something that [redacted] and [redacted] were already exploring. Depending on what they can deliver within the scope of this study, I might seek support on this from GiGL and/or the GLA GIS team to get some analysis done. In any case, I would want your input on the brief for such mapping/geospatial analysis exercise.
   As part of the release of the study, I am planning to get [redacted] resilience score added to the London Public Realm Tree map – and ensure the functionalities of this map are enhanced so that, one can filter based on tree location types (eg 'street trees', 'Parks and Open Space tree', 'Other location') and/or based on resilience score.
4. **Discussion**: a discussion section will be included in the next iteration of the report, helping to frame and interpret results. Without such framing, results could be really mis-interpreted (ie one could conclude that in inner London, one should only plant 3 species).
5. **List of alternative species:** Forthcoming.
6. [redacted].

Last, but not least: Welcome [redacted]

I am adding [redacted] to this distribution list, given his recent contribution to the Environment Committee.

[redacted] welcome to the (rather informal) steering committee for the London Public Realm Trees Climate Resilience study [redacted] and [redacted] are preparing for the London Urban Forest Partnership (GLA and FC are funding this work). For your information, I also attach the agreed scope of work for this project.

Thank you all for your time on this.

Kind regards,

[redacted]

London Urban Forest Plan Coordinator
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
To:
Cc:
Subject: Comments on report
Date: 23 June 2025 17:12:00
Attachments: UPL Interim Report June 2025 - London_AJ.pdf

Hi both,
I very much look forward to our discussions tomorrow!
3 things:

1. Should you need to reach me while you are on your way, I can be reached on [redacted]
2. The comments I had made on your report didn't appear in the version I circulated – I didn't notice in time that they hadn't uploaded properly. Just for your information, I attach a version where these comments are visible.
3. Final delegate list is as follow:

Organisation	Type of organisation	First name	Surname	Job Title
Forest Research	Academic / research	[redacted]		
Met Office	Academic / research			
Met Office	Academic / research			
Myerscough (and Urban Plant Lab)	Academic / research			
Royal Botanical Gardens, Kew (And Urban Plant Lab)	Academic / research			
Treeconomics	Consultant			
Oxleas Tree Contractor	Contractor			
Thames Chase Trust	eNGO			
DEFRA	Government / public body			
DEFRA	Government / public body			
Forestry Commission	Government / public body			
Forestry Commission	Government / public body			
Forestry Commission	Government / public body			
Greater London Authority	Local authority			
Greater London Authority	Local authority			
Hackney Tree Musketeers and London Borough of Islington / Hackney Tree Musketeers	Local authority			
LB Southwark	Local authority			
London Borough of Hammersmith & Fulham	Local authority			
London Borough of Islington	Local authority			
London Borough of Southwark	Local authority			
London Boroughs of Richmond and Wandsworth	Local authority			
Royal Borough of Kensington and Chelsea	Local authority			
Barcham	Tree Nursery			
Coles Nurseries	Tree Nursery			
Hackney Tree Musketeers	Tree Nursery			
Hackney Tree	Tree Nursery			

Musketeers		[redacted]	[redacted]
Hillier	Tree Nursery		
Hillier	Tree Nursery		
J. A. Jones Nursery	Tree Nursery		
Majestic Trees	Tree Nursery		
Paramount Plants	Tree Nursery		
Wyevale Nurseries	Tree Nursery		
Wyevale Nurseries	Tree Nursery		
Wyevale Nurseries	Tree Nursery		

Best,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
To: [redacted]

Subject: London Urban Forest Climate Resilience workshop
Importance: High

Good morning,

As a reminder, today's London Urban Forest Climate Resilience Workshop will be held from 13.00 until 16.30 in person on in at the Hackney Marshes Centre, in East London. Details on how to get to the venue can be found below, together with a recap of the workshop objectives and agenda.

VENUE: Hackney Marshes Centre <https://g.co/kgs/L1mWYf> , Off Homerton Road, Hackney E9 5PF.

Getting there by public transport via:

* Homerton Overground station + 308 bus (5 minutes ride from Homerton) / or walk (22 minutes from Homerton)
* Stratford station + the 308 bus (12 min from Stratford)

By car: Hackney Marshes is located just off the A12, and offers 184 car parking spaces.

OBJECTIVES

* Collate practitioner feedback on the accessibility and perceived relevance of the London Public Realm Tree Climate Resilience Assessment undertaken by Urban Plant Lab.

* Gather ideas on the implications and potential next steps stemming from the Assessment findings – with a particular focus on communications, further research, tree supply chain management, tree planting practices, and tree management.

The feedback and ideas gathered will inform:

(1) the content and presentation of final London Public Realm Tree Climate Resilience Assessment to be publicly released in the Autumn later this year

(2) the approach and main communication lines the Greater London Authority, the Forestry Commission, Kew and the LTOA will share to publicise the report

(3) the next steps the London Urban Forest Partnership will consider to follow-up on the report findings.

AGENDA

13.00 Arrival

13.05 Introductions

13.10 Presentation of method and findings from London's Public Realm Trees Climate Resilience Assessment by Urban Plant Lab, eg. [redacted] and [redacted] (45 minutes)

13.55 Plenary discussion: Clarifying questions and first reactions on key take-away (20 minutes)

14.15 Break (15 minutes)

14.30 Group work: Next steps and blockers (40 minutes)

15.10 Sharing (45 minutes)

15.55 Hackney Community Nursery visit (optional – until 16.30)

16.30 End

Background:

As part of the implementation of the London Urban Forest Plan 2025 <https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/parks-green-spaces-and-biodiversity/trees-and-woodlands/london-urban-forest-partnership> , the Greater London Authority and the Forestry Commission have worked jointly with members of the London Tree Officers Association to commission an assessment of the vulnerability of London's public realm tree population to climate change.

The latest work has been undertaken by:

* [redacted] Head of the Tree Collection at Kew Gardens, and co-author of the Royal Botanic Gardens, Kew's recent Planting for the Future: Kew's Landscape Succession Plan <https://www.kew.org/read-and-watch/landscape-succession-plan>
* [redacted] Senior Lecturer at Myerscough College, and co-author of the Trees and Design Action Group's Trees Species Selection for Green Infrastructure: A Guide for Specifiers <https://www.tdag.org.uk/tree-species-selection-for-green-infrastructure.html>

This project is designed to assess the climate resilience of London's public realm trees in light of anticipated temperature changes, water needs and water availability. It focuses on species representing more than 1% of London's public realm tree population, and also includes all UK native species found in London's public realm (trees in streets, parks and open space, housing land). Tree species information was supplied by London Boroughs as well as other public realm tree owners (such as the Royal Parks, Transport for London, etc). Altogether, the species included within the scope of this work represent 75% of London's 1.14 million public realm trees <https://apps.london.gov.uk/street-trees/> . Resilience scores have been developed for both inner and outer London locations to reflect the impact of the Urban Heat Island effect. The project also includes identifying a potential list of species/provenances providing a suitable alternative to those deemed most vulnerable to anticipated climate impacts.

This work builds upon an initial study released last year which focused on London's top 10 street trees and used a simpler methodology to assess climate resilience. The sobering results <https://forestrycommission.blog.gov.uk/2024/10/09/cultivating-resilient-trees-and-woodlands-in-london-a-model-for-all/> of this work provided an incentive to expand its scope as well as the range of data input / modelling approach informing of such assessment.

I look forward to our discussions later today

[redacted]

Senior Policy and Programme Officer

GREATERLONDONAUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

From: [redacted]
To: [redacted]
Subject: RE: London Public Realm Tree species data
Date: 09 July 2025 13:09:00

1/ If you are able to send me at some point this month an example or extract of what this could look like, in pdf or other image format (I can't open GIS files unfortunately), that would be great.
2/ Do you know where [redacted] stands on his ability to finish the report in early September, as per the schedule I sent on Monday? If he says 'I really can't', then I will push for a November release.

[redacted]

Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: Wednesday, July 9, 2025 1:01 PM
To: [redacted]
Subject: Re: London Public Realm Tree species data

Hi [redacted]
It would be used to represent to potential impact of the climate change on the current urban forest.
Kind regards
[redacted]
Sent from Outlook for Android

From: [redacted] <[redacted]london.gov.uk>
Sent: Wednesday, July 9, 2025 12:56:57 PM
To: [redacted] <[redacted]kew.org>
Subject: RE: London Public Realm Tree species data

CAUTION: This email originated from outside the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.
Report this email as Suspicious via Kew Service Desk

That's what GiGL has proposed to do!
On a separate note: during the 24 June workshop, you mentioned you had some GIS tiles that could help provide a spatial representation for your work on London's trees – what were you referring to?
This doesn't prevent exploring the other options [redacted] set out!
Thanks for letting me know,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted] <[redacted]kew.org>
Sent: Wednesday, July 9, 2025 9:01 AM
To: [redacted] <[redacted]london.gov.uk>
Subject: Re: London Public Realm Tree species data

CAUTION: This email originated from outside this organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Morning [redacted]
If using plants of the world online would be a massive step forward.
Kind regards
[redacted]

From: [redacted] <[redacted]london.gov.uk>
Sent: 07 July 2025 10:50
To: [redacted] <[redacted]myerscough.ac.uk>; [redacted] <[redacted]myerscough.ac.uk>; [redacted]kew.org>
Cc: [redacted] <[redacted]gigl.org.uk>
Subject: London Public Realm Tree species data

CAUTION: This email originated from outside the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.
Report this email as Suspicious via Kew Service Desk

Dear [redacted] and [redacted]
I hope this finds you well. I will be coming back to you shortly with (1) proposed timeframe for the public release of your final report and timetable to work towards that (2) notes summarising key points raised during our 24 June workshop and the comments I received on the Interim report.
This email is to discuss **Tree species data**. **I would like GiGL to update the Taxon information they hold, using the cleaned up data you have produced**.
We have recently received data from Croydon, but it doesn't include GIS coordinates. We believe this can still be reflected in total tree numbers you use and borough-level statistical analysis we

are provide on the datastore.
I am still chasing updated data from Bromley (we are currently using the dataset they provided us a few years back), Havering (they have never given us anything)…and Barking and Dagenham has come back to us saying they noticed they had probably missed a few trees, which they are in the process of sending us….
GiGL has offered to use your taxonomic categorisation ([redacted] as discussed this is Plants of the World Online) to clean up the Croydon data and any new data we receive in the future. To facilitate this, would it be possible please for you to send to [redacted] (CCd above)

1. The 'cleaned up' dataset you have generated to use for your analysis?
2. Any workflows/automation you might have set up to facilitate this?

Thank you very much,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk

From: [redacted]
To: [redacted] (Guest); [redacted]gmail.com
Subject: RE: London Public Realm Tree Resilience study: timeframe for release.
Date: 15 July 2025 17:44:00

Dear both,

As you might have picked up from my earlier email, we have decided to postpone the launch of your work until early November. I didn't hear from you on the September timeframe set out below – it seemed too rushed from my perspective for all of us to be really ready in time. The GLA has a lot on in October – so **early November is now what we are aiming for**.

I will work out an updated timetable based on this shortly.

In the meantime, [redacted] if you can, it would be great if you managed to squeeze in an answer to my request to send the cleaned London public realm tree dataset (e.g. with cleaned taxon) to [redacted], plus any tips or work flow you may have that could help GiGL's species team take over this data cleaning process and automate it!

As always: many thanks!

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: 07 July 2025 11:04
To: [redacted] ; [redacted] ; [redacted] (Guest)'
Subject: London Public Realm Tree Resilience study: timeframe for release.

Dear both,

I am working with our Coms team on a release date for your work.

The earliest option being considered is an October release, which then would require working to the following timetable:

- Final dataset cleaned up by GiGL (e.g. total number of tree & number of tree per species) sent to [redacted] by mid-**August** = your guidance needed on exact timeframe for GiGL to get the data to you [we now have some Croydon data and Barking and Dagenham have found new trees they overlooked sending data about…].
- First draft of the final report sent by [redacted] to [redacted] & [redacted] circulate to review group by COB on **16 September**.
- [redacted] to test Adobe Acrobat Accessibility Check on the draft version of the report, with a view to resolve any accessibility issues no later than **24 September** ('Pass' report sent to [redacted]
- [redacted] to collate review group comments received and send back to [redacted] by COB on **24 September**
- Final report incorporating comments + Adobe Acrobat Accessibility Check on final version of the report (showing a full 'Pass') sent to [redacted] on **30 September**.

Three questions:

1. Is that timetable workable for you?

2. By when would you need confirmation we go for this option, rather than a later release?
3. For this option to work, by when do you need the cleaned up data from GiGL (e.g. to get the total population size, and nb of tree per species)

I need to give my manager a steer on what our options are for releasing your work by 10am on Wednesday. If you were able to get back to me on the above by then, that would be much appreciated!

I hope the travels are going well, and the work super interesting!

Best,

[redacted]

P.S. Workshop notes to follow tomorrow!

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: Monday, July 7, 2025 10:50 AM
To: [redacted] <[redacted]myerscough.ac.uk>; [redacted] <[redacted]myerscough.ac.uk>; [redacted] (Guest) <[redacted]kew.org>
Cc: [redacted] <[redacted]gigl.org.uk>
Subject: London Public Realm Tree species data

Dear [redacted] and [redacted]

I hope this finds you well. I will be coming back to you shortly with (1) proposed timeframe for the public release of your final report and timetable to work towards that (2) notes summarising key points raised during our 24 June workshop and the comments I received on the Interim report.

This email is to discuss **Tree species data**. **I would like GiGL to update the Taxon information they hold, using the cleaned up data you have produced**.

We have recently received data from Croydon, but it doesn't include GIS coordinates. We believe this can still be reflected in total tree numbers you use and borough-level statistical analysis we are provide on the datastore.

I am still chasing updated data from Bromley (we are currently using the dataset they provided us a few years back), Havering (they have never given us anything)…and Barking and Dagenham has come back to us saying they noticed they had probably missed a few trees, which they are in the process of sending us….

GiGL has offered to use your taxonomic categorisation ([redacted] as discussed this is Plants of the World Online) to clean up the Croydon data and any new data we receive in the future. To facilitate this, would it be possible please for you to send to [redacted] (CCd above)

1. The 'cleaned up' dataset you have generated to use for your analysis?
2. Any workflows/automation you might have set up to facilitate this?

Thank you very much,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk

From: [redacted]
To: [redacted]
Subject: RE: London public realm trees - cleaned-up taxon names
Date: 06 August 2025 10:05:00
Attachments: image001.png
image002.png
image003.png
image004.png
image005.png
image006.png
image007.png
image008.png

Ok. Thank you very much.
On the London Public Realm Tree Map on the datastore (an update of which will be released at the same time as your study), we will include your resilience score, and I would also like to have reporting on each borough's performance against the Santamour benchmark – so that the message can be: resilience is not just about have climate resilient specie/individual trees, it's also about having a more diversity at the population scale... . For this I need the dataset to include genus and family.
Also, in the current version of the map on the Datastore, for everything but the most common tree species, the name currently shown on the map is "flowering plant", which renders the tool really dull from a community engagement perspective. The upcoming update will show the scientific name, but I also would like to include a common name. I feel we can't be promoting species diversification on the one hand while simultaneously be so narrow on the range of species we report on and give a recognisable name to!!!

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: 06 August 2025 09:52
To: [redacted]
Subject: Re: London public realm trees - cleaned-up taxon names

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There not a really a quick way.
Once it all complete and i have a look to see if i could work something out.
[redacted]

From: [redacted] <[redacted]london.gov.uk>
Sent: Wednesday, August 06, 2025 09:28
To: [redacted] <[redacted]kew.org>; [redacted] <[redacted]gigl.org.uk>
Subject: RE: London public realm trees - cleaned-up taxon names

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Report this email as Suspicious via Kew Service Desk

Brilliant!

Thank you[redacted]

Once we have a final list of species, do you have a quick way to:

1/ Append genus and family?

2/ Add a common name?

Thank you,

[redacted]

[redacted]
Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are: [redacted]

From: [redacted] <[redacted]kew.org>
Sent: 06 August 2025 08:41
To: [redacted] <[redacted]london.gov.uk>; [redacted] <[redacted]gigl.org.uk>
Subject: Re: London public realm trees - cleaned-up taxon names

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Morning All,

O the fun of plant names and taxonomy .

I have add some notes also.

GiGL unassigned names	Count	Powo (Kew) name	Note	notes	Powo link
Cornus alternifolia	**1**	*Cornus alternifolia*			

Cornus alternifolia L.f. | Plants of the World Online | Kew Science

Koelreuteria

1

Marsdenia

It's a genus

this would be **Koelreuteria paniculata common name Golden Rain Tree**

Koelreuteria Medik. | Plants of the World Online | Kew Science

Metasequoia

10

Metasequoia

This would Metasequoia glyptostroboides, common name Dawn Redwood

Metasequoia Hu & W.C.Cheng | Plants of the World Online | Kew Science

Populus x canadensis 'Serotina Aurea'

1

Populus × canadensis?

It's a hybrid

Populus × canadensis Moench | Plants of the World Online | Kew Science

Rhamnus

2

Rhamnus

It's a genus

Rhamnus L. | Plants of the World Online | Kew Science

Ribes speciosum

1

Ribes speciosum

...it's a shrub?

Ribes speciosum Pursh | Plants of the World Online | Kew Science

Sorbus mougeotii

11

Hedlundia mougeotii

correct name

Sorbus mougeotii | Plants of the World Online | Kew Science

Tsuga

1

Tsuga

It's a genus

Tsuga (Endl.) Carrière | Plants of the World Online | Kew Science

Ulmus minor

1

Ulmus minor

Ulmus minor Mill. | Plants of the World Online | Kew Science

Kew Name	GIGL Name	Powo (Kew)	Note	Powo link
Melianthaceae	Francoaceae	[Is it possible to deduct/assume a tree genus, to get a bit more specific than a family name?]	This is a family... The Powo name is *Francoaceae*. This family doesn't seem to include many trees...maybe we can infer from this name a likely tree genus??? [redacted] note-I would be very surprised if this was planted in London urban forest	Francoaceae A.Juss. | Plants of the World Online | Kew Science
Cupressus arizonica var. glabra	Hesperocyparis glabra	*Hesperocyparis glabra*	Powo says the name it uses for this is *Hesperocyparis glabra* ....but do we really have this? [redacted] note- yes i would aspect to see this	Cupressus arizonica var. glabra | Plants of the World Online | Kew Science
Fallopia japonica	Reynoutria japonica	*Reynoutria japonica*	This is Japanese's knot weed. not a tree	Fallopia japonica | Plants of the World Online | Kew Science
Sorbus glabriscula	Sorbus pseudohupehensis	*Sorbus glabriuscula?*	These are 2 different species, both accepted by Powo (see link right). Note that the correct spelling of Sorbus glabri[redacted]scula[redacted] note, sorbus taxonomy is highly discussed as lots of different opinions on this the naming. lets just go for Sorbus glabriuscula	Sorbus glabriuscula McAll. | Plants of the World Online | Kew Science Sorbus pseudohupehensis McAll. | Plants of the World Online | Kew Science

Hope this helps,

kind regards

[redacted]

From: [redacted] london.gov.uk>
Sent: Wednesday, August 06, 2025 07:47
To: [redacted] gigl.org.uk>; [redacted] kew.org>
Subject: RE: London public realm trees - cleaned-up taxon names

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Report this email as Suspicious via Kew Service Desk

Good morning [redacted]

Do you think you can give us a hand with this?

I have added 3 columns to [redacted] tables below, based on what I found looking up Powo online. I have highlighted in yellow the four lines where I am really not sure…

Thank you for your time on this,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted] london.gov.uk

My pronouns are: [redacted]

From: [redacted] gigl.org.uk>
Sent: 05 August 2025 16:59
To: [redacted] london.gov.uk>; [redacted] kew.org>
Subject: RE: London public realm trees - cleaned-up taxon names

Hi both,

I've been through and compared the list, about 60 taxon names need small changes, so I will add this to our standardisation process. There are some names that were quite different, and I therefore wanted to confirm I have these correct, please could you confirm these names:

Kew Name	GiGL Name	Powo (Kew)	Note	Powo link
Melianthaceae	**Francoaceae**	**[Is it possible to deduct/assume a tree genus, to get a bit more specific than a family name?]**	**This is a family… The Powo name is *Francoaceae*. This family doesn't seem to include many trees…maybe we can infer from this name a likely tree genus???**	**Francoaceae A.Juss. | Plants of the World Online | Kew Science**
Cupressus arizonica var. glabra	**Hesperocyparis glabra**	*Hesperocyparis glabra*	**Powo says the name it uses for this is *Hesperocyparis glabra* ….but do we really have this?**	**Cupressus arizonica var. glabra | Plants of the World Online | Kew Science**
Fallopia japonica	**Reynoutria japonica**	*Reynoutria japonica*		**Fallopia japonica | Plants of the World Online | Kew Science**
Sorbus glabriscula	**Sorbus pseudohupehensis**	*Sorbus glabriuscula?*	**These are 2 different species, both accepted by Powo (see link right). Note that the correct spelling of Sorbus glabri[redacted]scula**	**Sorbus glabriuscula McAll. | Plants of the World Online | Kew Science** **Sorbus pseudohupehensis McAll. | Plants of the World Online | Kew Science**

There was one species name in Kew's list which didn't obviously match to ours, this is *Populus candicans*. In addition, the below table shows names from GiGL's database that could not align with Kew's names.

GiGL unassigned names	Count	Powo (Kew) name	Note	Powo link
Cornus alternifolia	**1**	*Cornus alternifolia*		**Cornus alternifolia L.f. | Plants of the World Online | Kew Science**
Koelreuteria	**1**	*Marsdenia*	**It's a genus**	**Koelreuteria Medik. | Plants of the World Online | Kew Science**
Metasequoia	**10**	*Metasequoia*	**It's a genus**	**Metasequoia Hu & W.C.Cheng | Plants of the World Online | Kew Science**
Populus x canadensis 'Serotina Aurea'	**1**	*Populus × canadensis?*	**It's a hybrid**	**Populus × canadensis Moench | Plants of the World Online | Kew Science**
Rhamnus	**2**	*Rhamnus*	**It's a genus**	**Rhamnus L. | Plants of the World Online | Kew Science**
Ribes speciosum	**1**	*Ribes speciosum*	**…it's a shrub?**	**Ribes speciosum Pursh | Plants of the World Online | Kew Science**
Sorbus mougeotii	**11**	*Hedlundia mougeotii*		**Sorbus mougeotii | Plants of the World Online | Kew Science**
Tsuga	**1**	*Tsuga*	**It's a genus**	**Tsuga (Endl.) Carrière | Plants of the World Online | Kew Science**
Ulmus minor	**1**	*Ulmus minor*		**Ulmus minor Mill. | Plants of the World Online | Kew Science**

I have also attached the spreadsheet I used to work all this out. Could you assist with any of the unassigned names?

Note that counts in the spreadsheet differ as we have added more data, but they've been useful for matching up names.

If I could help before week's end that would be great. If not I will go ahead with what I've managed so far.

Kind regards,

[redacted]

[redacted] ([redacted])

Partnership & Communications Officer

Greenspace Information for Greater London CIC

E: [redacted]gigl.org.uk
Office: c/o London Wildlife Trust, Fivefields, 8-10 Grosvenor Gardens, Victoria, SW1W 0DH

From: [redacted] london.gov.uk>
Sent: 01 August 2025 12:59
To: [redacted] gigl.org.uk>
Cc: [redacted] kew.org>
Subject: RE: London public realm trees - cleaned-up taxon names

That sounds good, thanks [redacted]

[redacted] happy to be guided by you and [redacted] on common names.

Many thanks,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted] london.gov.uk

My pronouns are: [redacted]

From: [redacted] gigl.org.uk>
Sent: 01 August 2025 12:45
To: [redacted] london.gov.uk>
Cc: [redacted] kew.org>
Subject: RE: London public realm trees - cleaned-up taxon names

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Hi [redacted]

It doesn't contain alignments with our species list, but from a quick comparison, there aren't too many differences and I may be able to sort it myself through list comparison next week. Hopefully that won't take too long.

The only issue I might have is if I identify new taxon names in Kew's list that don't obviously match any of ours, so I may come back with queries next week if that's ok.

[redacted] – could you also let me know if [redacted] changed any of the common names?

Many thanks,

[redacted]

[redacted]

Partnership & Communications Officer

Greenspace Information for Greater London CIC

E: [redacted] gigl.org.uk
Office: c/o London Wildlife Trust, Fivefields, 8-10 Grosvenor Gardens, Victoria, SW1W 0DH

Greenspace Information for Greater London CIC Registered Office: 10 Queen Street Place, London EC4R 1BE.
Community Interest Company limited by guarantee registered in England and Wales number 8345552
The contents of this email are confidential and intended solely for the use of the individual to whom it is addressed.

From: [redacted] london.gov.uk>
Sent: 01 August 2025 12:06
To: [redacted] gigl.org.uk>
Cc: [redacted] kew.org>
Subject: FW: London public realm trees - cleaned-up taxon names

Hi [redacted]

Please find attached the species list [redacted] provided.

Are you able to work with this to standardise taxon names in the full database?

Best

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are:[redacted]

From: [redacted] <[redacted]kew.org>
Sent: 01 August 2025 11:59
To: [redacted] <[redacted]london.gov.uk>
Subject: Re: London public realm trees - cleaned-up taxon names

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Hi[redacted]

This is the updated species list.

Cheers

[redacted]

From: [redacted] <[redacted]london.gov.uk>
Sent: 31 July 2025 16:38
To: [redacted] <[redacted]kew.org>
Cc: [redacted]gmail.com <[redacted]gmail.com>; [redacted] <[redacted]gigl.org.uk>; [redacted] <[redacted]myerscough.ac.uk>
Subject: London public realm trees - cleaned-up taxon names

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Report this email as Suspicious via Kew Service Desk

Hi[redacted]

I think[redacted] is now in annual leave – and I guess he didn't have time before he left to send to[redacted] the London tree dataset with standardised Taxon names, based on Kew's Plants of the World classification.

This is a problem for us – as[redacted] is expected to handover to our GIS team the cleaned dataset (including Croydon, Bromley and possibly a few addition from Barking and Dagenham) by mid-August – so that this, in turn, can be used for an update of the London public realm map…and you can use the updated total tree numbers for your final report.

So, as you will see from[redacted] email below, all she needs, if it's available is a csv list of the re-aligned species names (old vs new).

Thanks for your help with this,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are:[redacted]

From: [redacted] <[redacted]gigl.org.uk>
Sent: 31 July 2025 16:30
To: [redacted] <[redacted]london.gov.uk>
Subject: RE: Tree map update

CAUTION: This email originated from outside this organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Yes - we'd just need to be able to match that species dictionary to ours, which isn't possible with just the list alone I'm afraid. I assume[redacted] work has aligned the Plants of the World online dictionary to the NHM dictionary that is used in the original dataset. If it's available, all we'd need from[redacted] is a csv list of the re-aligned species names (old vs new).

Thanks,

[redacted]

[redacted]

Partnership & Communications Officer

Greenspace Information for Greater London CIC

E: [redacted]gigl.org.uk
Office: c/o London Wildlife Trust, Fivefields, 8-10 Grosvenor Gardens, Victoria, SW1W 0DH

From: [redacted] <[redacted]london.gov.uk>
Sent: 31 July 2025 16:20
To: [redacted] <[redacted]gigl.org.uk>
Subject: RE: Tree map update

The categorisation to use is: Plants of the World Online

I am pretty confident [redacted] will be able to send the data [redacted] cleaned up.

Best,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are: [redacted]

From: [redacted] <[redacted]gigl.org.uk>
Sent: 31 July 2025 16:18
To: [redacted] <[redacted]london.gov.uk>
Subject: RE: Tree map update

[redacted] reacted to your message:

From: [redacted] <[redacted]london.gov.uk>
Sent: Thursday, July 31, 2025 3:16:41 PM
To: [redacted] <[redacted]gigl.org.uk>
Subject: RE: Tree map update

Hi [redacted]

I will liaise with [redacted] from Kew, to ensure you get what you need.

Best,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are: [redacted]

From: [redacted] <[redacted]gigl.org.uk>
Sent: 31 July 2025 16:15
To: [redacted] <[redacted]london.gov.uk>
Subject: RE: Tree map update

CAUTION: This email originated from outside this organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi [redacted]

I received an out of office from [redacted] until the 21st August. I think we'll have to go ahead with our classifications for now. I've been assured by our species team that the dictionary we use is widely used in species work (although all dictionaries have disputes and discrepancies!). As part of our standardisations, we've also cleaned up a lot of the species name issues too.

Happy to update with [redacted] version if he sends it on his return. Sound ok?

Thanks,

[redacted]

[redacted]

Partnership & Communications Officer

Greenspace Information for Greater London CIC

E: [redacted]gigl.org.uk
Office: c/o London Wildlife Trust, Fivefields, 8-10 Grosvenor Gardens, Victoria, SW1W 0DH

Greenspace Information for Greater London CIC Registered Office: 10 Queen Street Place, London EC4R 1BE.
Community Interest Company limited by guarantee registered in England and Wales number 8345552
The contents of this email are confidential and intended solely for the use of the individual to whom it is addressed.

From: [redacted] <[redacted]london.gov.uk>
Sent: 31 July 2025 15:19
To: [redacted] <[redacted]gigl.org.uk>
Cc: [redacted] <[redacted]myerscough.ac.uk>
Subject: RE: Tree map update

Hi [redacted]

I definitely would like to squeeze Bromley in. They promised they would send us their data!

Did you get what you needed from [redacted] to (1) import the clean taxon data he cleaned up for the dataset you had sent over to him (2) standardise the Taxon fields from Croydon, and the extra Barking and Dagenham trees you added to the overall dataset?

Thank you,

[redacted]

[redacted]

Senior Policy and Programme Officer

GREATER**LONDON**AUTHORITY

City Hall, Kamal Chunchie Way, London E16 1ZE

www.london.gov.uk

[redacted]london.gov.uk

My pronouns are: [redacted]

From: [redacted] <[redacted]gigl.org.uk>
Sent: 29 July 2025 16:57
To: [redacted] <[redacted]london.gov.uk>
Subject: Re: Tree map update

CAUTION: This email originated from outside this organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi [redacted]

Just a quick update on tree things – we're very close with the final dataset, but I'd like to add on a few extra days to the original timeline in order to test everything if that would be ok. Could we aim to get the final dataset to you next week? I haven't heard from Bromley either, would you like to do another chase to see if we can squeeze them in?

Thanks,

[redacted]

[redacted] ([redacted]

Partnership & Communications Officer

Greenspace Information for Greater London CIC

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: Workshop notes
Date: 29 August 2025 17:48:00
Attachments: 24 June 2025 Climate Resilience Workshop_Structured summary and notes.docx

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Hi both,

Please find attached the long awaited notes from our 24 June workshop.

I will follow-up on Monday with [redacted] at Gigl to ensure you get the latest tree numbers, from the latest update of the species database… (so that you can update the tree numbers shown in the report – I am keen for these figure to match those that will be shown on the London Public Realm Map portal) or a full copy of the database – whichever works best for you

Best

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

London's Public Realm Trees Climate Resilience Assessment Workshop on Interim Report findings

Held on 24 June 2025, at the Hackney Marshes Centre, from 13:00 until 17:00

Contents

Workshop objectives

- Collate practitioner feedback on the accessibility and perceived relevance of the London Public Realm Tree Climate Resilience Assessment undertaken by Urban Plant Lab.
- Gather ideas on the implications and potential next steps stemming from the Assessment findings – with a particular focus on communications, further research, tree supply chain management, tree planting practices, and tree management.

The feedback and ideas gathered is expected to inform:

(1) the content and presentation of final London Public Realm Tree Climate Resilience Assessment to be publicly released in the Autumn later this year

(2) the approach and main communication lines the Greater London Authority, the Forestry Commission, Kew and the LTOA will share to publicise the report

(3) the next steps the London Urban Forest Partnership will consider to follow-up on the report findings.

Workshop agenda

- 13.00 Arrival
- 13.05 Introductions
- 13.10 Presentation of method and findings from London's Public Realm Trees Climate Resilience Assessment by Urban Plant Lab, eg. [redacted] and [redacted] (45 minutes)
- 13.55 Plenary discussion: Clarifying questions and first reactions on key take-away (20 minutes)
- 14.15 Break (15 minutes)
- 14.30 Group work: Next steps and blockers (40 minutes)
- 15.10 Sharing (45 minutes)
- 15.55 Hackney Community Nursery visit (optional – until 16.30)
- 16.30 End

Workshop attendees

[redacted]	[redacted]	LB Southwark	[redacted]
[redacted]	[redacted]	Met Office	[redacted]

[redacted]	Wyevale Nurseries	[redacted]
	Hackney Tree Musketeers	
	Wyevale Nurseries	
	Hackney Tree Musketeers	
	Forest Research	
	Hillier	
	Wyevale Nurseries	
	Majestic Trees	
	Coles Nurseries	
	Greater London Authority	
	Greater London Authority	
	Myerscough (and Urban Plant Lab)	
	Hillier	
	Greater London Authority	
	Forestry Commission	
	J. A. Jones Nursery	
	Royal Botanical Gardens, Kew (and Urban Plant Lab)	
	London Borough of Hammersmith & Fulham	
	Met Office	
	Paramount Plants	
	London Borough of Islington	
	Treeconomics	
	London Boroughs of Richmond and Wandsworth	
	Forestry Commission	
	Royal Borough of Kensington and Chelsea	
	London Borough of Southwark	
	DEFRA	
	Barcham	
	Oxleas Tree Contractor	
	Hackney Tree Musketeers and London Borough of Islington / Hackney Tree Musketeers	
	Forestry Commission	

Summary of workshop points

1. Communicating research findings

1.1 Audience-specific communication strategy

- **Develop tailored communication strategies** for distinct audiences, including:
    - Local authorities (tree officers, planners, decision-makers, budget holders)
    - Practitioners (e.g. TfL, developers, landscape architects)
    - Nurseries and the wider tree supply chain
    - Government agencies (e.g. Defra)
    - Community groups and volunteers
    - General public
    - Media

Next step: Communication planning should be a **core focus**, ensuring each audience receives messaging in a form that supports their role and decisions.

1.2 Enable local/customer empowerment

- Findings must be **interpretable at the borough/local/tree manager level**, where decision-making authority lies.
- **Buy-in happens locally**; communication should empower action at this scale.
- Promote **questions of provenance** at the local level, e.g., "Where are our trees coming from?" — especially in local authority–nursery relationships.

1.3 Framing the climate context: microclimates over administrative boundaries

- Move away from a simplistic **"Inner vs Outer London"** model.
- Instead, communicate climate vulnerability through **microclimatic zones** (e.g., areas of high vs low Urban Heat Island effect).
    - Example: some inner London areas near the Thames may be cooler than outer areas.
    - Recognise both **negative and positive** microclimate effects (e.g. cooling from leaky hosepipes or other localised effects).

Implication: Ground-level interpretation and planting decisions depend on how the climate context is framed.

1.4 Policy and practice alignment

- Findings should **inform briefs for landscape architects** and other specifiers – clarity on preferred species and acceptable substitutes is essential.
- Findings should be **reflected in local planning policy**, helping officers guide species selection in developments.
- Need for **compliance and accountability mechanisms** to ensure species selected at planning stage are actually planted (or suitable substitute).

Suggested action: Could be taken forward by the **LTOA working planning party** and the **LI policy team**

1.5. Managing risk in public messaging

- Prior **releases of similar research (e.g. Kew study)** have shown this work can attract a lot of attention.
- Need careful **media engagement planning** to:
    - Prevent misrepresentation/oversimplification that could skew planting decisions.
    - But also: **Use emotion tactically (e.g., fear)** to inspire urgency and action.

1.6 Provide contextual understanding

- Communicate the *why* behind tree selection shifts to **those planting trees at the community level**.
- Clarify that changes are not just about climate resilience, but also about **tree survival, canopy longevity, and urban cooling**.
- Messaging needs to move beyond **tree numbers and carbon sequestration**, and focus on:
    - **Tree longevity**
    - **Cooling benefits**
    - **Importance of aftercare & quality of planting pit**
    - **Layered approach,** where trees are part of wider greening (shrub) supporting urban resilience

2. Enhancing data quality and use

2.1 Standardisation & consistency

- **Adopt a unified taxonomic backbone** for all public realm tree owners (starting with London Boroughs) and nurseries. Suggested source: **Plants of the World Online**.
- **Standardise tree data collection methodologies** across boroughs and major landowners.
- The **lack of consistency in current data** is a major obstacle to collaboration and analysis.

Outcome: Enables better comparative analysis, shared platforms, and coordinated decision-making across London.

Suggested action: Could the LTOA Data working party take this forward?

2.2 Tree health, pests & climate Interactions

- **Analyse tree felling and mortality data** across boroughs to:
    - Identify trends in species decline.
    - **Validate and backcheck** the outcomes of climate resilience modelling with real-world evidence.
- Establish systems to **monitor and compile data on tree health** on a pan-London scale. Explore how **remote sensing technologies** can support large-scale and consistent health monitoring.
- **Integrate understanding of pests and diseases (P&D)** into resilience assessments:
    - Some tree species **highly susceptible to P&D may also be well-adapted to climate change**.
    - Need to **understand how climate change interacts with P&D risks**, and share that information more widely.
    - Suggest further refinement of the resilience score, potentially by **emulating Defra/Forestry Commission's approach** for woodland species mix resilience assessments.

Outcome: Builds a more holistic and evidence-backed view of species viability, combining modelling with on-the-ground data and biotic stress factors

2.3 Research integration & higher Education Involvement

- **Involve higher education**: Encourage Masters, PhD students, and research groups to contribute to filling knowledge gaps, testing species, and refining models.

Outcome: Expands research capacity and provides a pipeline of new insights to inform planning and practice.

2.4. Climate modelling & vulnerability analysis

- **Borough-level application:** Each borough should analyse the vulnerability of its own tree population using the scores, since **overall resilience depends on local species composition.** Tools/templates may be useful for consistent borough-level analysis?
- **Further data/guidance on "Moderately resilient" species:** Many of London's most common species fall into this intermediate category. Can further research provide some insight into
    - **Lifespan outlooks** under different scenarios, and clues on possible approaches to extend viability.
    - **Succession planning support:** indicative timelines and **prioritisation frameworks** to stage replacement or diversification.
- Collaborate with **Met Office/JULES** for improved modelling inputs, while balancing against over-granularity that risks overlooking species adaptability.
- Emphasise **risk management**: treat "Low/Moderate" species as potential tipping points requiring proactive, prioritised planning.

Outcome: Moves from scores to actionable, borough-level management strategies, especially for species in the "Low/Moderate" resilience band

2.5 Managing uncertainty & model Limitations

- Recognise and communicate the **inherent uncertainties** in:
    - Climate projections
    - Plant trait data
    - Interactions between pests/diseases and changing climate
- Be cautious with **high-resolution climate modelling**:
    - If modelling becomes too granular, it could narrow down suitable species too much.
    - Need to balance precision with understanding of **species plasticity/adaptability**.

Outcome: Avoid overprescribing narrow solutions; support flexible, informed decision-making.

2.6 Broader application of Kew/London's approach?

- Explore the potential for a **national roll-out of London's species climate resilience assessment methodology**.

Outcome: Shares London's leadership and helps align approaches across the UK?

3. Nursery engagement & tree production supply chain

3.1 Provenance & stress tolerance

- **Current gap:** Provenance of commercially available tree stock is often unknown.
    - This undermines understanding of **stress tolerance**, which historically has been less of a nursery priority than aesthetics.
- Recommendation:
    - Encourage nurseries to **identify and record provenance** (seed source or parent material for clonal production).
    - Make **provenance a key consideration** for future-proofing nursery stock.

Outcome: Improves resilience confidence in planting stock and supports better long-term performance.

3.2 Feeding research back into production

- Need mechanisms to **feed research findings into nursery practice** in ways that are effective and practical.
- Use findings to **inform review of gaps in nursery catalogues**, and guide new production strategies.
- Explore **contract growing arrangements** with councils or central Government to:
    - Guarantee provenance.
    - Address gaps in the market.
    - De-risk investment in novel or climate-resilient species/provenances.
- Defra innovation grants (e.g. Seed Sourcing Grant, TPIF) could help **support innovation and de-risking**.

Outcome: Aligns nursery production with long-term resilience goals while reducing commercial exposure.

3.3 Collaboration vs Competition in the nursery sector

- Current nursery sector dynamics are described as **"frosty" and competitive**, limiting collaboration.
- Suggestions:
    - Local authorities should adopt a **more open approach about their needs**, allowing nurseries to specialise.

    - Consider **consortium models** (e.g. Sweden's cooperative approach funding joint research, trials, and field collections) – though past attempts in the UK have struggled.
- Debate: should provenance and resilience innovation be driven by **market competition** (rewarding proactive nurseries) or by c**oordinated sector-wide engagement**? ...probably a bit of both?

Outcome: Collaboration could reduce risk for nurseries and increase alignment with demand, but buy-in may require cultural change in the UK nursery sector.

3.4 Risk management & timescales

- **Balancing risk:**
    - Nurseries cannot carry 100% of the risk in sourcing and trialling new material – shared models of risk are needed.
    - Consider **contract growing led by central Government**, with local authorities purchasing stock via Government channels to help de-risk nurseries?
- **Timescales misalignment:**
    - Human/political timescales vs business cycles vs tree lifecycles often don't match.
    - Long-term contracts and clearer demand forecasts are essential to reconcile these mismatches.
- Ongoing question: is current **Government funding (e.g. TPIF, Seed sourcing grant, etc)** sufficient to de-risk the scale of investment required?

Outcome: Risk-sharing and longer-term certainty are prerequisites for securing resilient nursery production.

3.5 Market demand & customer Influence

- **Customers extend beyond local authorities** – TfL, housing developers, and landscape architects are also key actors shaping demand.
- Need to **bring these customers into the conversation**, to clarify needs and align production.
- Messaging is critical to **maximise customer influence**, ensuring buyers value provenance and resilience (see section 1 above).

Outcome: Expands the demand signal beyond boroughs, creating stronger and more predictable incentives for nurseries.

3.6 Research, innovation & future-proofing

- Further research needed into **traits and novel species** to diversify future stock.
- Use of **local nurseries for testing and trials** could help derisk early stages.
- Develop an **urban resilient seed bank with provenance tailored to London**.
- Accept that **importing seed will be necessary** to access diverse material.
- Review nursery catalogues for **future-proofing relevance** against climate resilience evidence.

Outcome: Supports a more adaptive and experimental approach to tree production, while grounding it in resilience needs.

3.7 Certainty & long-term planning

- Nurseries require **certainty and long-term growing contracts** to confidently invest in stock aligned with resilience priorities.
- Open question: what **further research outputs** are needed to give nurseries confidence that what they invest in producing will be the "right" trees for London's future? (see section 2 on enhancing data quality & use)

Outcome: Stability of demand and confidence in research findings are essential to underpin nursery investment decisions.

4. Policy alignment & governance

4.1 Partnership & collective action

- Encourage **London boroughs to work in partnership** to secure the trees they need, sharing demand signals and reducing competition.
- Could this be taken forward by the LTOA Climate Adaptation working party?

Outcome: Stronger collective leverage with nurseries and more consistent access to resilient species.

4.2 Role of Defra, grants & incentives

- **Defra is a critical player** and must be adequately briefed on the research findings.
- Grants should be used to **steer greater diversity in planting** and avoid over-reliance on vulnerable species.
- Risk that boroughs with **highly skilled tree officers** (also often working in borough enjoying **high canopy cover/pro-active planting programmes)** could dominate

access to resilient new species, e.g. risk of **worsening inequities** between boroughs, with less-resourced areas falling further behind.

- GLA & Defra/Forestry Commission could set **criteria for accessing tree planting grants** to:
    - Incentivise diversity.
    - Discourage planting of low-resilience species (rather than promoting a "top species list" that could create perverse demand pressures or supply bottlenecks).
    - Prioritise low tree equity areas

Outcome: Funding and incentives become powerful levers to align practice with research evidence, while protecting species diversity and avoiding inequities.

4.3. Planning Policy & GLA's role

- GLA should play an **active role in encouraging the right shift through planning policy**.
- Proposal: adopt a **metric or metrics to promote tree diversity** as part of planning requirements.
- Challenge: current practice often defaults to **like-for-like restocking**, which perpetuates vulnerabilities.

Outcome: Embed resilience thinking into planning processes and development approvals.

4.4 Strategic leadership & consistency

- Proposal for a **GLA Tree Strategy** to provide a consistent, overarching framework / set of principles for borough-level tree strategies (?)
- Would help align practice across London and reduce inconsistencies in approaches to climate resilience.

Outcome: A London-wide strategic framework to coordinate local action, supported by national levers (Defra/FC grants).

Full workshop notes

Initial discussion

- Agree consistent taxonomic backbone for all London public realm tree owners (starting with London Boroughs) and nurseries – suggest relying on Plants of the World Online.
- Planting pit environment often accelerates stresses (e.g. street trees will be under greater stress than park trees)
- Will always be microclimate nuance (e.g. side of street)
- Provenance of tree stock available from commercial nurseries is unknown – leading to lack of understanding of how stress-tolerant they are
    - Stress tolerance also historically less of a priority than aesthetics
- Currently observing vulnerability of species to current and future high-risk pests – unclear how long Defra review will take…
    - [redacted] @ Defra also scored according to pest and disease – suggested we swap methodology
- LUFP includes actions re: long-term monitoring protocol
- Clonal selections more common for street planting, rather than seed selections. TRY dataset and own data set from botanic gardens used.
- Increased need for smaller trees due to management reasons rather than stress-tolerance reasons. However, smaller trees require less resource to manage and tend to establish better at a younger age
- Average rather than conservative estimates
- Biggest source of error is not knowing where trees currently planted have come from (nurseries unsure of original provenance of source material)

Group Work

Table 1:

- **Easy wins:**
    - Promote the adoption of a single taxonomic backbone
    - Promote standardisation of tree data collection among London boroughs (and other major tree owners)
- **Better communicating findings:**
    - Define and understand London as a set of microclimates (not inner London vs greater London – based on administrative boundaries)
        - As a start, better presented as **high vs low Heat Island Effect** (e.g. inner London location closer to River Thames cooler than some outer London locations) = will make a difference to the application of this work / implementation at ground level.

        - In the future: might be useful to dig deeper in the range of microclimates (discussion: Microclimates works both ways. Yes we can have a negative microclimate impact, but positive impacts also possible e.g. leaky hosepipes).
    - Allow for this work to be interpreted at borough / local / tree manager level: buy-in happens at a local level - this is where the authority/capacity for action lies.
    - Advise that the provenance question be systematically asked (and answered): Borough to ask their nurseries: "where are my trees coming from?"
- **Nursery production:**
    - Feed research back to producer: what's the most effective way?
    - Encourage nurseries to put greater efforts into identifying provenance of trees – seed stock or parent tree for clonal production:
        - Discuss possibility of contract growing with councils – targeting gaps in current nursery catalogue offer – looking to guaranteeing the provenance of the tree stock thus produced.
        - Speak to Defra about nursery innovation grants to support this.

<u>Table 2:</u>

- **Education and training**
    - Promote the development of a Coms strategy for different audiences around the findings from this work
    - Climate literacy training
    - Can Masters / PhDs and other research project conducted as part of higher education feed into this?

- **Funding:**
    - Promote the GLA's £12m Green Roots Fund
    - Defra funding?

Local authority process review

- Review asset management and inventory metrics and adopt standardisation
- Pathways to interdepartmental collaboration
- Work towards private realm inventory data
- Tree pit improvement: really important to emphasise, not just species selection
- LTOA Working Party on data standardisation

Species selection

- More collaboration between nurseries – so that the industry supplies the trees the market wants, but there needs to be commercial viability for growers. Increased

collaboration can be a means to de-risk – currently relationships can be a "frosty". To facilitate this:

  - More open approach from local authorities on their needs: each nursery has their skillset on what they can grow, the nurseries could agree an approach for each nursey to specialise into certain species
  - In Sweden: a consortium of nurseries is in place, with all contributing a relatively modest amount (approx. £10,000 each) to fund Henrik Sjoman's research (enabling trials and field collection trips) and they all benefit from the outcomes of that research, and give e-plant status to trees suited to climate – little success in replicating this approach in the UK despite some attempt… UK nurseries collaborate with nurseries abroad rather than fellow UK nurseries – still a rather competitive approach.
  - There isn't necessarily consensus among nurseries on this approach (e.g. provenance): so is it best to leave it to competition between nurseries, letting market feedback reward those investing in this field (e.g. let demand be the key driver)? Or do we focus on a nursery-specific communication to get this information across to the sector more effectively and achieve better buy-in? If nurseries' whole business model doesn't work on provenance, then, its inevitable that there is going to be resistance and there is a need to understand the hardship that will need to be overcome to make this viable… Nurseries will grow tree from any provenance: the issue is the risk: whatever is desired from the steppes for example first has to be proven to be possible to commercially grow in the UK: balance is needed of where that risk lies: a lot of time and effort could be dedicated to sourcing and trialing new materials, but where things don't work out, the nurseries cannot carry 100% of that risk. More collaboration is needed to balance that risk.
  - While market demand is the key driver of this – timescales are an issue: Human vs business vs tree timelines don't match – We need to find a way to align these timelines into a project whole!
  - Is existing Government funding adequate to help derisk such efforts? E.g. Defra's Seed Sourcing Grant; Defra's Tree Production Innovation Fund (TPIF): £200,000. Need to discuss with Claire.
  - Could the Government contract grow with nurseries (thereby de-risking the investment), and local authorities buy-off the Government who would then recuperate its investment?
- Continue supporting LTOAs/communities on species selection, factoring the evidence of the resilience of species
- Factor an understanding of the impacts of resilience on canopy cover in 2050 and 2090

Table 3:

Sharing/collation of data & data consistency

- Ensure consistency of data – current lack of consistency is a major obstacle
- More sharing of information between public landowners and nurseries, and between nurseries to influence the species produced/planted
- Could there be a national roll-out of London's approach to assessing climate resilient species?
- Monitor & compile data on tree health in urban areas. Could this be supported by remote sensing solution?
- Understand uncertainty – uncertainties around climate + uncertainties around plant traits: how does this affect overall approach

Pests and Diseases and policy

- Keep in mind that some of the tree species most susceptible to p&d are perhaps also best climate adapted. Knowledge of how climate interacts w/ p&d is critical: need more sharing of this information
- Consider climate resilience and tree health resilience in tree and woodland strategies.

Provenance and nursery selection

- Long-term planning for nurseries – place more importance on provenance.
- Review relevance of tree catalogue offer for future proofing

Sharing/messaging/facilitating an understanding of the research

  - How do we communicate findings to practitioners / those making decisions on the ground?

Table 4:

Communication & messaging

- Sharing research and how it's communicated more widely, needs to be carefully considered:
  - Dissemination of findings to practitioners / those delivering on the ground - incl TfL, housing developers, landscape architects – e.g. those specifying what is being planted. Briefs for landscape architects need to be clear re: species selection.
  - Potential for local planning policy to better reflect this research – to help officers to direct the type of trees being planted in development. There is also a need for those who deliver to be held accountable/enable compliance: even if both local planning authorities and landscape architects are on top of tree species selection, by the time contractors make tree purchases, a lot of

substitutions can happen. There can be a lot of deviation compared to the scheme approved at planning stage. From a nursery perspective, it's inevitable that at one point a given species will become unavailable, so to manage this, there needs to be list of alternatives as certain species are always in high demand
        - A topic for the LTOA working planning party to consider?
    - How do we manage the messaging to the wider media? Previous experience has shown this work (e.g. release of Kew study) attracts a lot of attention. Risk that
      risk of strategic message gets overlooked

Influencing / supporting shift in tree production & addressing associated commercial viability issues

- Discussed as previous group
- Who are the customers? Need to bring customers around the table more (e.g. TfL, housing developers, landscape architects – not just London Boroughs' tree officers). Careful management of messaging is a key tool to maximise customer influence (as highlighted above).
- Need certainty and long-term tree growing contracts – what research is needed to ensure that what we invest in producing are the right things? How can we improve the quality of our projection to help de-risk this investment? Further research needed into traits and novel species to retain diverse tree stock?
- Use of local nurseries for testing and trials

Concern / tree equity

- Concern that parts of London have highly skilled tree officers (likely already with high tree canopy cover) may have higher demand for new tree species – negative impact on tree equity: how do we avoid inadvertently increasing London's existing disparities?

[question] **Urban Plan Lab approach to providing recommendation on suitable alternative to species deemed most vulnerable?**

Look at what's available in the trade: make recommendations on substitutions based on what's available in the trade. E.g. exploit the rich long tail in the dataset (underused species)

Horizon scanning for best provenance novel species that can feed into the supply chain. Getting novel species or genotypes into the production system is a 15-20 year endeavour. The contract growing needs to focus on this, to de-risk this investment.

How can we give the research more teeth? Use tree species as grant criteria? BUT may cause

- overdemand of very limited number of species if "top species" are set too narrowly. OR could discourage certain species instead, which would be better at encouraging diversity
- Make recommendations to nurseries for at-risk species – focus on species currently available, as novel species take 15-20 years to get into the system. Need to derisk for nurseries as much as possible

Table 5:

- **Planting and species selection**: we need to increase the diversity of treescapes by promoting a broad mix of planting. This requires:
    - Thinking outside the box of commonly planted tree species – what species are we not planting that exist in European Steppe?
    - Find space to plant an urban resilient seed bank with provenance tailored to London
    - Influence tree production supply chain tree nurseries rely upon to secure the production of species/provenances suitable for London.

- **Partnership and engagement**:
    - London boroughs to work in partnership to secure the trees they need
    - From a Media engagement perspective: Allow fear to set in! To inspire action
    - Place pressure on our partners to source tolerant species
    - Advocacy & outreach work w/ community group on tree species (not just cultivars)
    - Work with landowners and explore funding options to create localised supply lines – secure space for planting the seed bank.

- **Data:**
    - Use data from Urban Plant Lab to establish climate vulnerability of tree population at borough level: retain species that are in the high/moderate categories for as long as possible, create a response/strategy for most vulnerable
    - Liaise with Met Office's climate-vegetation interaction team (JULES): could higher res climate data help with this research? – [redacted] already working with them (Univ of Exeter doing modelling)
        - Higher resolution climate data – however, if we drill down too much we will limit the species susceptible to be identified as suitable, overlooking the fact that most species have a level of plasticity/adaptability
    - Tree felling data could help understand risks, mortality data, etc. – can be used to backcheck research ([redacted] has done it for the Kew analysis, and looked at mortality data to identify trends).
        - BUT availability of tree data varies significantly between boroughs

- **Obstacles + approaches**
    - Resources: money, space, time
    - Increased need for risk management – could there be more insight provided by the research into what's going to happen to the 'Moderate' trees, to help tree managers strategise an approach (e.g. a prioritised management/succession approach)
    - Having a GLA Tree Strategy promoting consistency across boroughs – provide an overarching framework borough's tree strategies could feed into
    - GLA&FC could also stipulate certain criteria for accessing grants – better to incentivise diversity and avoidance of low resilience species that promote a list of 'resilient' species (likely to be purchased by a limited number of boroughs with greater delivery capacity – contributing to inequity)
    - Standardise tree data – using plant World Data online for taxon information + FR work

Table 6:

Sharing information and education

- Disseminate research findings across the board: nurseries, central Government, government agencies, local authorities (incl decision makers and budget holders), the community groups / volunteers / wider public (those who plant trees at a local level need to understand why local authorities are making those changes), the media
- All these different groups need different/very specific coms strategies / tailored messages: this ought to be a key focus in next steps.
- To get political buy-in: need a complete overhaul of what's understood w/ tree planting:
    - Headline is always tree numbers – not helpful, because while it might be possible to plant a lot of trees and tick the numbers box, these trees might be dead in 10 years.
    - Often pitched in terms of carbon sequestration: the message, in urban areas, should be strongly emphasising cooling. (although this is emphasised by tree trait and context/urban form): a strategy is needed to optimise cooling benefit. Has to be a multi-layered green infrastructure approach, include shrub!
    - Importance of aftercare and funding for aftercare (how can it be that Defra's latest grant still only cover 2 years of maintenance, despite all the feedback that has happened?). Big education needed on capital/revenue.
- Possibility of using public facing GIS map showing where they want trees – many inner London boroughs have planted on most available planting sites available. Only available planting space is implies taking away car parking space. If public are allowed to map trees we may find they're willing to get rid of parking space for tree planting

Policy changes:

- Grant schemes. Defra is a critical player and must be adequately briefed. Defra should use its grants to steer greater diversity
- Planning policy: GLA need to take an active role in encourage the right shift. Having a metric to support the promotion of greater tree diversity would be a good starting point. Restocking is often happening like for like…

Production

- Importing seeds
- Nurseries need to be able to make decisions now to make species available in time – significant commercial risks

From: [redacted]
To: [redacted]
Cc: [redacted]gmail.com
Subject: Key messages from your work...
Date: 02 September 2025 12:56:00
Attachments: UPL_Interim Report June 2025 - London_AJ.pdf

Dear [redacted] and [redacted]
As discussed with [redacted] yesterday, please find below the overview I sent to our Coms lead to try and describe the scope of your work, and, critically, key findings emerging from it.
As mentioned to [redacted] I think there are issues with how figures are currently presented in the report: there are big risks of mis-interpretation.
We do need however some overarching headlines; so I do not want throw the baby out with the bath water!
Based on yesterday's discussion w/ [redacted]

- For presenting percentages, we need to be very clear on what wider whole the percentage is calculated against.
- For a headline on London's public realm trees, it would make sense to focus on the whole public realm tree population, while noting that you only reviewed the resilience of roughly 75% of it (e.g. it is desirable to express some of your findings like this: "available evidence points to *at least* x% of London's public realm trees having some degree of vulnerability to anticipated changes in London's climate") . You could still also have the percentages expressed in relation of the sample you focused on ("between 65% and 87% of the sample studied – which accounts for ¾ of London's public realm trees, showed some degree of climate vulnerability – depending on assumptions made on their planting environment").
- For percentages given on the performances of trees in high urban heat island areas (which is a better way to articulate the conditions you modelled, rather than 'inner London'), then again, we need to be clear on what whole the percentage is calculated against…. The table on page 13 of the Interim report can easily be read as "7% of inner London's trees have low resilience to climate change"…when in fact, what you are showing is "7% of London's public realm trees studied (representing ¾ of the whole public realm tree population) would have low resilience to climate change is the whole of London had very high incidence of UHI, akin to what is found is the type of conditions currently found in central London"
- With [redacted] we agreed that, before we start thing of how we account for the performance of trees in areas with high incidence of overheating (which does open a bit of a challenge in terms of how we articulate findings / impacts on the whole tree population), you should look at how many species had very different scores for high vs low UHI, and to what degree these particular species where unevenly distributed (using the existing London Tree Map).

I re-attach the (old) comments I had made on your interim report (I didn't update the points on the % figures, captured above) – I just wanted to make sure this was still on your radar.
Here is what I communicated to my Coms colleague:
Report scope:

1. **Use best available scientific evidence to assess and score the climate resilience of London's most common public realm tree species (e.g. any species representing more than 1% of the total count, plus all the UK native species used in the public realm) = in total 42 species**. Two resilience scores were produced for each species considered: one reflecting climate vulnerability if the tree is located in a

built-up area prone to overheating (high urban heat island effect), and another for more benign growing London conditions (outside high UHI areas).

2. **Provide a list of alternative suitable tree species (already used in London's public realm), that could be used more – e.g. offering a suitable substitute for the trees with the greatest vulnerability to climate**
3. **Recommended next steps, factoring feedback from key nursery practitioners & London public realm tree managers**.

Outputs 2 and 3 from above are not yet part of the Interim report currently available (and attached) – but will feature in the final version.

Headlines from this work, which no other city has undertaken on a similar scale as London, will be:

1. Climate change is having and is expected to continue to have a significant impact on London Trees and woodland, with evidence pointing to between 65% and 87% of London's most common public realm trees showing some degree of vulnerability.
2. Levels of vulnerability however vary depending on the characteristics of each tree species and its planting location, with harshest locations typically found in more built-up areas prone to over-heating. Available evidence suggests that up to 7% of have no record of being able to handle such conditions.
3. 70% of London's trees are one of 25 or so species: that's not very diverse. A key step to achieve greater resilience to climate change is to diversify the trees planted.
4. There are many species currently suitable that could be used more - diversification will be key to enhancing the resilience of London's tree population – not just planting climate resilience species.
5. *Other messages on key recommendations will be available in mid-late Sept.*

-!- IMPORTANT NOTE: please take the percentages identified above as indicative. Final figures are not yet available as calculations -as currently made – reflect the percentage of trees affected, based on the subset that was analysed (800,000 trees or so) – rather that a % of the total tree population or a % of the total tree population affected by high incidence of UHI in point (2).

Best,

[redacted]
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JUNE 18, 2025

CLIMATE RESILIENCE OF LONDON'S PUBLIC REALM TREES

INTERIM REPORT

ANDREW HIRONS AND KEVIN MARTIN
URBAN PLANT LAB

URBAN PLANT LAB

Introduction

London's urban forest contributes to the wellbeing of residents and visitors in manifold ways. Whilst as a whole, London's urban forest is taxonomically rich, relatively few species dominate. To support an agenda of strategic diversification, it is critical to evaluate the vulnerability of London's trees to a changing climate. The Greater London Authority, on behalf of London's Urban Forest Partnership, to conduct analysis on the likely resilience of London's trees to future climate scenarios. This directly supports goal 1 of the London Urban Forest Plan.

Goal 1: Enhance the resilience of London's urban forest to the threats posed by climate change, pests and diseases

Figure 1: Goal 1 from the London Urban Forest Plan 2025 Actions Update[1] directly relates to the objectives of this project.

Project Overview

Using collated tree inventories from local authorities within the Greater London Authority area, species representing greater than 1% or more of the urban forest species composition will be evaluated for their likely resilience to the SSP3 climate scenario.

Objectives

The project will:

I. Determine the resilience of London's urban tree species to a future climate scenario.
II. Recommend strategical tree management objectives and priorities to mitigate climate-related risks to London's urban forest.

[1] London Urban Forest Plan – 2025 Actions Update

Phase I – Review of taxonomic composition London's public realm trees.

The Greenspace Information for Greater London CIC provided a data cache compiling tree inventory data for most of London's boroughs on the 20th December 2024. Together with the Richmond data that followed[2], this provided a dataset with 1,062,321 observations (trees) recorded.

As the database had not been cleaned, the first task was to evaluate the dataset and understand which values would not be able to be included in the analysis going forward. We decided to remove data from non-woody plants and observations with too high a taxonomic level, i.e., those records that only included a botanical family name and not a genus or species name (Box 1). This then gave 1,087, 376 records.

Box 1: Removed observation data

'Acizzia', 'Anacardiaceae', 'Araliaceae', 'Arecaceae', 'Arecales', 'Bignoniaceae', 'Biota', 'Cannabaceae', 'Caprifoliaceae', 'Celastraceae', 'Chlorophyta', 'Cudoniella acicularis', 'Cupressaceae', 'Ericales', 'Exochorda', 'Fabaceae', 'Fallopia baldschuanica', 'Fallopia japonica', 'Garryales', 'Geometridae', 'Gymnodinium chiastosporum', 'Gymnodiniaceae', 'Hippothoa', 'Homona coffearia', 'Ipimorpha subtusa', 'Lauraceae', 'Lythraceae', 'Melianthaceae', 'Moraceae', 'Myrtaceae', 'Oleaceae', 'Pica', 'Pinaceae', 'Pinales', 'Pinophyta', 'Pinopsida', 'Plantae', 'Rosa', 'Rosacea', 'Rutaceae', 'Sapindales', 'Saxifragaceae', 'Saxifragales', 'Subacronicta megacephala', 'Ulmaceae', 'Wisteria sinensis', 'Zabrachia tenella'

N.B. - Some records from these groups are included, but the observations were removed where only the botanical order or family information was included as such a coarse level of resolution is not helpful in subsequent analysis.

Next it was important to harmonise hybrid names in order that names were recorded in a consistent way so that the same hybrid was not recorded in two different ways (Box 2).

Box 2 : Harmonised hybrid names

"Arbutus unedo x andrachne = A. x andrachnoides" = "Arbutus x andrachnoides",
"Berberis darwinii x empetrifolia = B. x stenophylla" = "Berberis x stenophylla",
"Cotoneaster frigidus x salicifolius = C. x watereri" = "Cotoneaster x watereri",
"Cotoneaster salicifolius x dammeri = C. 'Hybridus Pendulus'" = "Cotoneaster Hybridus Pendulus",
"Cupressus macrocarpa x Xanthocyparis nootkatensis = X Cuprocyparis leylandi" = "X Cuprocyparis leylandii",
"Forsythia suspensa x viridissima = F. x intermedia" = "Forsythia x intermedia",
"Ilex aquifolium x perado = I. x altaclerensis" = "Ilex x altaclerensis",
"Laburnum anagyroides x alpinum = L. x watereri" = "Laburnum x watereri",
"Larix decidua x kaempferi = L. x marschlinsii" = "Larix x marschlinsii",
"Malus atrosanguinea x niedzwetskyana = M. x purpurea" = "Malus x purpurea",
"Malus baccata x prunifolia = M. x robusta" = "Malus x robusta",
"Osmanthus decorus x delavayi = O. x burkwoodii" = "Osmanthus x burkwoodii",
"Platanus occidentalis x orientalis = P. x hispanica" = "Platanus x hispanica",
"Populus alba x tremula = P. x canescens" = "Populus x canescens",
"Populus balsamifera x deltoides = P. x jackii" = "Populus x jackii",
"Populus nigra x deltoides = P. x canadensis" = "Populus x canadensis",
"Populus nigra x laurifolia = P. x berolinensis" = "Populus x berolinensis",
"Prunus spinosa x domestica = P. x fruticans" = "Prunus x fruticans",

[2] Data for Richmond was provided on the 5th March 2025

"Pterocarya fraxinifolia x stenoptera (P. x rehderiana)" = "Pterocarya x rehderiana",
"Quercus cerris x suber = Q. x crenata" = "Quercus x crenata",
"Salix alba x babylonica = S. x sepulcralis" = "Salix x sepulcralis",
"Salix euxina x alba = S. x fragilis" = "Salix x fragilis",
"Sorbus aucuparia x aria = S. x thuringiaca" = "Sorbus x thuringiaca",
"Tilia cordata x dasystyla = T. x euchlora" = "Tilia x euchlora",
"Tilia platyphyllos x cordata = T. x europaea" = "Tilia x europaea",
"Ulmus glabra x minor x plotii = U. x hollandica" = "Ulmus x hollandica",
"Viburnum farreri x grandiflorum = V. x bodnantense" = "Viburnum x bodnantense",
"Viburnum lantana x rhytidophyllum = V. x rhytidophylloides" = "Viburnum x rhytidophylloides"

As the analysis for this report cannot resolve cultivar resilience scores, the cultivars present in the dataframe were recoded to represent the species level.

Box 3: Cultivars recoded to species

"Acer platanoides 'Drummondii'" = "Acer platanoides",
"Acer platanoides 'Schwedleri'" = "Acer platanoides",
"Acer pseudoplatanus 'Brilliantissimum'" = "Acer pseudoplatanus",
"Acer pseudoplatanus 'Leopoldii'" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma erythrocarpum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma purpureum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma variegatum" = "Acer pseudoplatanus",
"Betula pendula 'Laciniata'" = "Betula pendula",
"Betula pubescens Ehrh. var. pubescens" = "Betula pubescens",
"Chamaecyparis lawsoniana 'Erecta Viridis'" = "Chamaecyparis lawsoniana",
"Cupressus arizonica var. glabra" = "Cupressus arizonica",
"Fagus sylvatica 'Asplenifolia'" = "Fagus sylvatica",
"Fagus sylvatica 'Dawyck'" = "Fagus sylvatica",
"Fagus sylvatica 'Pendula'" = "Fagus sylvatica",
"Fagus sylvatica 'Purpurea'" = "Fagus sylvatica",
"Fagus sylvatica Heterophylla group" = "Fagus sylvatica",
"Fraxinus angustifolia 'Raywood'" = "Fraxinus angustifolia",
"Fraxinus angustifolia subsp. oxycarpa" = "Fraxinus angustifolia",
"Fraxinus excelsior 'Diversifolia'" = "Fraxinus excelsior",
"Fraxinus excelsior 'Jaspidea'" = "Fraxinus excelsior",
"Mespilus germanica 'Nottingham'" = "Mespilus germanica",
"Pinus contorta var. latifolia" = "Pinus contorta",
"Pinus nigra subsp. laricio" = "Pinus nigra",
"Platanus" = "Platanus x hispanica",
"Populus candicans" = "Populus x candicans",
"Populus candicans 'Aurora'" = "Populus x candicans",
"Populus nigra 'Italica'" = "Populus nigra",
"Populus nigra 'Plantierensis'" = "Populus nigra",
"Populus nigra subsp. betulifolia" = "Populus nigra",
"Populus x canadensis 'Marilandica'" = "Populus x canadensis",
"Populus x canadensis 'Regenerata'" = "Populus x canadensis",
"Populus x canadensis 'Serotina'" = "Populus x canadensis",
"Prunus avium 'Plena'" = "Prunus avium",
"Prunus cerasifera var. pissardii" = "Prunus cerasifera",
"Prunus domestica subsp. insititia" = "Prunus domestica",
"Prunus Maackii" = "Prunus maackii",
"Quercus robur forma fastigiata" = "Quercus robur",
"Salix cinerea subsp. oleifolia" = "Salix cinerea",
"Salix x sepulcralis 'Chrysocoma'" = "Salix x sepulcralis",
"Taxodium" = "Taxodium distichum",
"Taxus baccata 'Fastigiata'" = "Taxus baccata",

"Tilia platyphyllos 'Rubra'" = "Tilia platyphyllos",
"Tilia 'Petiolaris'" = "Tilia tomentosa",
"Tilia tomentosa 'Petiolaris'" = "Tilia tomentosa",
"Ulmus glabra 'Exoniensis'" = "Ulmus glabra",
"Ulmus glabra 'Horizontalis' (Pendula)" = "Ulmus glabra",
"Ulmus minor agg." = "Ulmus minor",
"Ulmus minor subsp. minor" = "Ulmus minor"

Next the shrub and climber species were removed.

Box 4: Shrub and climber observations that have been removed

'Azara', 'Berberis darwinii', 'Berberis x stenophylla', 'Buddleja', 'Buddleja alternifolia', 'Buddleja davidii', 'Ceanothus', 'Cordyline australis', 'Cotinus', 'Cotinus coggygria', 'Cotoneaster', 'Cotoneaster Hybridus Pendulus', 'Cotoneaster conspicuus', 'Cotoneaster franchetii', 'Cotoneaster integrifolius', 'Cotoneaster salicifolius', 'Cotoneaster x watereri', 'Cytisus', 'Cytisus battandieri', 'Cytisus scoparius', 'Elaeagnus umbellata', 'Euonymus europaeus', 'Euonymus japonicus', 'Euonymus latifolius', 'Forsythia', 'Forsythia x intermedia', 'Frangula alnus', 'Fremontodendron californicum', 'Genista aetnensis', 'Genista hispanica', 'Griselinia', 'Griselinia littoralis', 'Hedera', 'Hedera helix', 'Homona coffearia', 'Ligustrum ovalifolium', 'Ligustrum vulgare', 'Lonicera periclymenum', 'Luma apiculata', 'Mahonia', 'Osmanthus', 'Osmanthus heterophyllus', 'Osmanthus x burkwoodii', 'Philadelphus', 'Philadelphus coronarius', 'Phillyrea latifolia', 'Photinia', 'Photinia davidiana', 'Pittosporum', 'Pittosporum tenuifolium', 'Pyracantha', 'Pyracantha atalantoides', 'Pyracantha coccinea', 'Rhamnus cathartica', 'Rhododendron', 'Rhododendron ponticum', 'Ribes', 'Ribes sanguineum', 'Rosa canina', 'Rosa rugosa', 'Rubus cockburnianus', 'Rubus fruticosus agg.', 'Viburnum', 'Viburnum davidii', 'Viburnum lantana', 'Viburnum opulus', 'Viburnum rhytidophyllum', 'Viburnum tinus', 'Viburnum x bodnantense', 'Viburnum x rhytidophylloides'

Following these cleaning processed the dataset had 1,087,320 observations, these were comprised of 47 botanical families.

Box 5: Botanical families represented in London's public realm trees

(number of species within each family in parenthesis)

Adoxaceae (2), Altingiaceae (2), Anacardiaceae (2), Aquifoliaceae (3), Araliaceae (2), Araucariaceae (3), Arecaceae (2), Asparagaceae (2), Betulaceae (26) Bignoniaceae (2), Brassicaceae (1), Buxaceae (2), Celastraceae (1), Cephalotaxaceae (2), Cornaceae (8), Cupressaceae (29), Dicksoniaceae (1) Elaeagnaceae (4), Ericaceae (3), Fabaceae (15), Fagaceae (24), Garryaceae (1), Ginkgoaceae (1), Grossulariaceae (1), Juglandaceae (10), Lamiaceae (1), Lauraceae (4), Magnoliaceae (5) Malvaceae (9), Moraceae (5), Myrtaceae (6), Nothofagaceae (5), Oleaceae (12), Paulowniaceae (1), Pinaceae (49), Platanaceae (3), Rhamnaceae (1), Rosaceae (69), Rutaceae (2), Salicaceae (28), Sapindaceae (29), Simaroubaceae (1), Tamaricaceae (5), Taxaceae (2), Theaceae (1), Tracheophyta (2), Ulmaceae (9).

This cleaning then results in 408 unique observations for tree species [TaxonName], these can be seen in Appendix 1 – Supplementary data. It should be noted that this may inflate the overall number of species featured in London's public realm as some 'TaxonName' observations which relate to the species level are actually recorded as a genus, not a species. For example, 10,353 trees are recorded as 'Betula' with no species name. Similar issues are observed with most major genera. However, as it is

impossible to determine which species to allocate the pooled group, these genus level 'species' have been preserved. Importantly, it is very unlikely that a major tree species has not been recorded but the relative proportions maybe slightly misrepresented. Unfortunately, this is just a source of error as a result of the underlying dataset.

In total 23 species (TaxonName) met the criteria of representing 1% or greater of London's public realm trees. A further 20 species were included to ensure that all native trees were included in the analysis as these species will also be important to consider in future urban forest management strategies. In total 43 species have been taken forward for focused climate resilience analysis.

Table 1: Final list of 43 species (TaxonName) included in the further climate resilience analysis.

TaxonName	TaxonFamil	TaxonGenus	Count	Percentage
Prunus	*Rosaceae*	*Prunus*	81045	7.45
Platanus x hispanica	*Platanaceae*	*Platanus*	73688	6.78
Quercus robur	*Fagaceae*	*Quercus*	62628	5.76
Acer platanoides	*Sapindaceae*	*Acer*	51038	4.69
Fraxinus excelsior	*Oleaceae*	*Fraxinus*	49190	4.52
Acer pseudoplatanus	*Sapindaceae*	*Acer*	47396	4.36
Tilia x europaea	*Malvaceae*	*Tilia*	39142	3.60
Carpinus betulus	*Betulaceae*	*Carpinus*	33737	3.10
Acer campestre	*Sapindaceae*	*Acer*	30041	2.76
Betula pendula	*Betulaceae*	*Betula*	29396	2.70
Prunus avium	*Rosaceae*	*Prunus*	28039	2.58
Malus	*Rosaceae*	*Malus*	24912	2.29
Crataegus monogyna	*Rosaceae*	*Crataegus*	24254	2.23
Tilia	*Malvaceae*	*Tilia*	24154	2.22
Aesculus hippocastanum	*Sapindaceae*	*Aesculus*	22610	2.08
Pyrus	*Rosaceae*	*Pyrus*	20236	1.86
Prunus cerasifera	*Rosaceae*	*Prunus*	16937	1.56
Tilia cordata	*Malvaceae*	*Tilia*	16699	1.54
Sorbus aucuparia	*Rosaceae*	*Sorbus*	15299	1.41
Ilex aquifolium	*Aquifoliaceae*	*Ilex*	13201	1.21
Robinia pseudoacacia	*Fabaceae*	*Robinia*	11839	1.09
Betula	*Betulaceae*	*Betula*	11050	1.02
Sorbus aria	*Rosaceae*	*Sorbus*	10461	0.96
Fagus sylvatica	*Fagaceae*	*Fagus*	9099	0.84
Tilia platyphyllos	*Malvaceae*	*Tilia*	9093	0.84
Taxus baccata	*Taxaceae*	*Taxus*	8280	0.76
Populus nigra	*Salicaceae*	*Populus*	8241	0.76
Sorbus	*Rosaceae*	*Sorbus*	7756	0.71
Acer	*Sapindaceae*	*Acer*	7179	0.66
Fraxinus	*Oleaceae*	*Fraxinus*	6902	0.63
Pinus sylvestris	*Pinaceae*	*Pinus*	5530	0.51

Alnus glutinosa	*Betulaceae*	*Alnus*	5506	0.51
Prunus padus	*Rosaceae*	*Prunus*	4387	0.40
Betula pubescens	*Betulaceae*	*Betula*	4018	0.37
Crataegus laevigata	*Rosaceae*	*Crataegus*	3180	0.29
Salix caprea	*Salicaceae*	*Salix*	2839	0.26
Corylus avellana	*Betulaceae*	*Corylus*	2189	0.20
Malus sylvestris	*Rosaceae*	*Malus*	2062	0.19
Populus tremula	*Salicaceae*	*Populus*	1609	0.15
Sorbus torminalis	*Rosaceae*	*Sorbus*	669	0.06
Quercus petraea	*Fagaceae*	*Quercus*	295	0.03
Juniperus communis	*Cupressaceae*	*Juniperus*	146	0.01
Salix pentandra	*Salicaceae*	*Salix*	12	0.00

For the final reporting, these data can be visualised in a variety of different ways to express how the tree demographic data is distributed. An example of this can be seen for the top 50 trees found in London's public realm trees (Figure 2).

Figure 2: Example of data visualisation of tree demographic data. Please note, other logos can be added when appropriate permissions have been sought.

Phase II – Evaluating climate resilience for the focus trees.

It is clear that even under the current climate scenario, central London – typified by the City of London – is already subject to a substantive urban heat island effect (Figure 3).

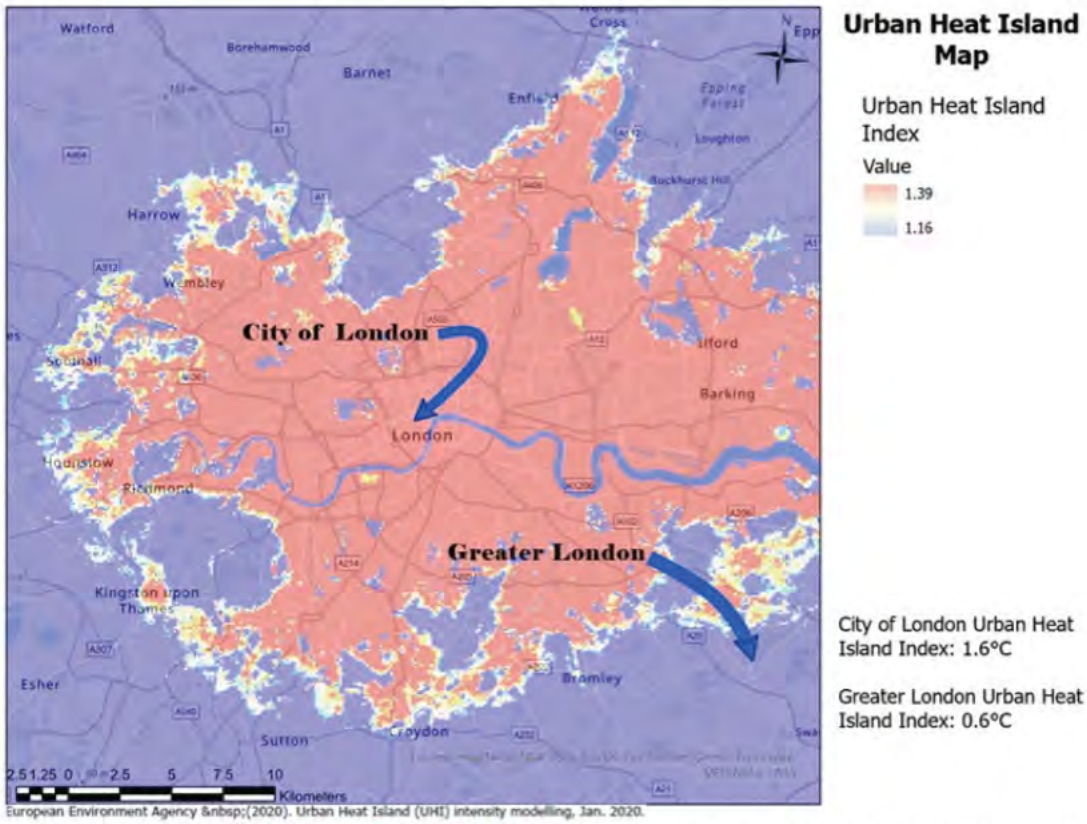

Figure 3: Urban heat island of London. Indicative locations for City of London and Greater London shown by arrows.

Under future climate scenarios the climate pressure with respect to tree growing conditions is set to intensify (Figure 4).

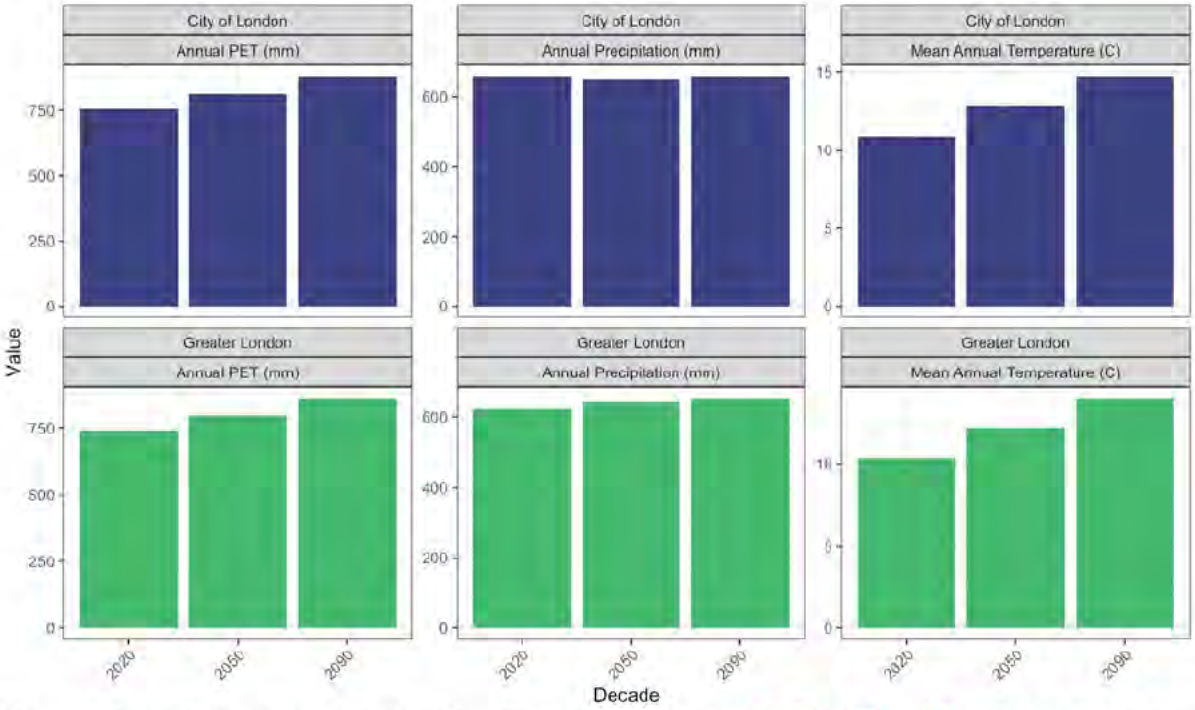

Figure 4: Key climate metrics for the City of London and Greater London, based on site locations given in Figure 3.

From the perspective of establishing, growing and maintaining trees, the climate in London is set to become more challenging for many species. This is mainly as a function of the increase in mean annual temperature as the precipitation is relatively stable. As the increase in temperature effects the annual potential evapotranspiration rates water deficits are likely to become more acute even in the circumstance where precipitation levels are maintained.

Understanding the climate resilience of a species is challenging as it is likely to depend not only on the species but also on the ecotypic provenance of the tree in question. Thus, there may be both intraspecific and interspecific variation in climate resilience across the trees used in London's public realm. Furthermore, the quality of the data used to inform the resilience may have a material influence on the outcome statements associated with the species.

Expertise at Urban Plant Lab is both in the use of plant traits and climate modelling tools that can be used to infer tree species resilience to climate. No single metric gives an infallible estimation of resilience, we have decided to develop a novel composite score for climate resilience based on three key plant traits that are instructive in relation to ecological strategy and stress resilience[3] (wood density (WD), leaf dry matter content (LDMC), leaf turgor loss point (TLP)) and species distribution modelling (SDM). Whilst there are a multiplicity of techniques that could be used to evaluate stress resilience, it is critical when screening large inventories that extensive datasets already exist.

[3] Sjöman, H., Hirons, A. and Martin, K.W., 2025. Species-specific evaluation of growth and environmental tolerance for ecosystem services–evaluation from a botanic tree collection. *Urban Ecosystems*, *28*(3), p.114.

Wood Density (WD)
Wood density (g cm^3) is a trait that integrates a number of aspects of ecological strategy. Species with higher density wood are found in more stressful sites that require greater investment in stress resilience and defence, whereas those with less dense wood are more competitive on fertile sites, but less resilient to stress[4]. Temperature has been found to be a major, global driver for wood density variation[5], thus it is instructive when evaluating tree stress resilience to future climate scenarios.

Leaf Dry Matter Content (LDMC)
Research has shown[6] that LDMC (mg g^{-1}) is related to stress resilience: species with a low LDMC are more vulnerable to heat and drought than those with a high LDMC. Higher LDMC reflects a greater investment in leaf tissue robustness that is necessary to cope with periods of water deficit and represents a more conservative ecological strategy.

Turgor Loss Point (TLP)
The leaf water potential at turgor loss (-MPa) is a quantifiable measure as it directly quantifies leaf and plant drought tolerance. The more negative the TLP, the longer key physiological functions, such as hydraulic conductance and stomatal conduction, can be maintained under soil drying[7]. It is widely used in ecological studies and in research used to inform tree selection for urban environments[8].

Global plant trait data (TRY Database)[9] were combined with data collected from our research group and other published literature. The chosen traits were then clustered into four groups using k-means[10] to provide an individual trait score of one to four. In this way, we allocate the trait score using statistical methodology that is informed by global datasets rather than making subjective decisions on the threshold values between scores. For example, global wood density was evaluated and clustered to give figure 5, these cluster scores were then extracted for the species in our focus group.

[4] Chave, J., Coomes, D., Jansen, S., Lewis, S.L., Swenson, N.G. and Zanne, A.E. (2009) Towards a worldwide wood economics spectrum. *Ecology letters*, *12*(4), pp.351-366.
[5] Mo, L., Crowther, T.W., Maynard, D.S., Van den Hoogen, J., Ma, H., Bialic-Murphy, L., Liang, J., De-Miguel, S., Nabuurs, G.J., Reich, P.B. and Phillips, O.L., 2024. The global distribution and drivers of wood density and their impact on forest carbon stocks. *Nature Ecology & Evolution*, pp.1-18.
[6] Petruzzellis, F., Tordoni, E., Di Bonaventura, A., Tomasella, M., Natale, S., Panepinto, F., Bacaro, G. and Nardini, A. (2021) Turgor loss point and vulnerability to xylem embolism predict species-specific risk of drought-induced decline of urban trees. *Plant Biology*, *24*(7), pp.1198-1207.
[7] Bartlett, M.K., Scoffoni, C. and Sack, L. (2012) The determinants of leaf turgor loss point and prediction of drought tolerance of species and biomes: a global meta-analysis. *Ecology letters*, *15*(5), pp.393-405.
[8] Hirons, A.D., Watkins, J.H.R., Baxter, T.J., Miesbauer, J.W., Male-Muñoz, A., Martin, K.W., Bassuk, N.L. and Sjöman, H. (2021) Using botanic gardens and arboreta to help identify urban trees for the future. *Plants, People, Planet*, *3*(2), pp.182-193.
[9] Kattge, J., Bönisch, G., Díaz, S., Lavorel, S., Prentice, I.C., Leadley, P., Tautenhahn, S., Werner, G.D., Aakala, T., Abedi, M. and Acosta, A.T. (2020) TRY plant trait database–enhanced coverage and open access. *Global change biology*, *26*(1), pp.119-188.
[10] Hartigan, J.A. and Wong, M.A., 1979. Algorithm AS 136: A k-means clustering algorithm. *Journal of the royal statistical society. series c (applied statistics)*, *28*(1), pp.100-108.

The species score for the WD, LDMC, TLP and SDM were then averaged to give a composite score. Therefore, the lowest possible score would be one and the highest possible score would be four. Species scoring between one to two were evaluated as having *Low resilience*, species scoring between two and three were evaluated as having *moderate resilience* and species scoring between three and four were evaluated as having *high resilience*. This was done for both Greater London and Inner London (Table 3 and Table A2).

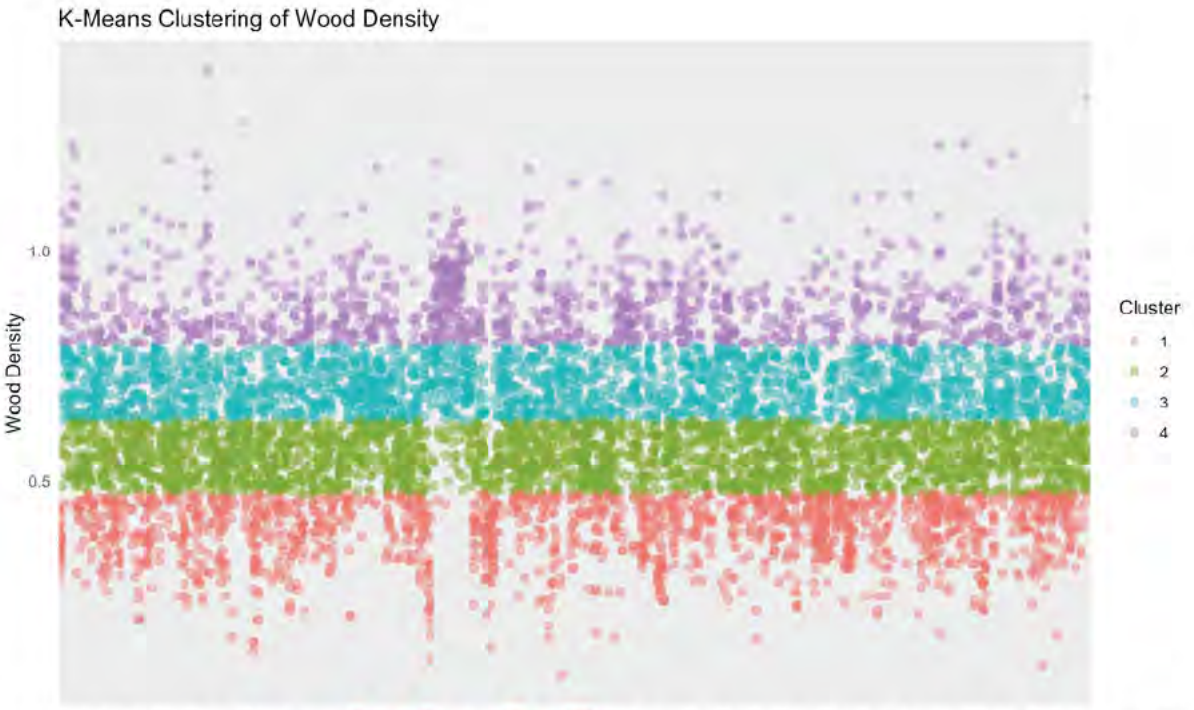

Figure 5: Example of the way in which cluster analysis was used to derive a four-point score that will contribute to the overall climate resilience score. In the case of the wood density trait: 4 was awarded for a density above 0.78 (g/cm^3); 3 was awarded for between 0.61 – 0.78; 2 was awarded between 0.46 and 0.61; and, a score of 1 for <0.46. Cluster levels were determined using the k-means method. Similar analysis was used for the other plant trait data (LDMC, TLP).

The species distribution modelling is based on analysis of global plant and climate data, this facilitates the plotting of species distributions in the context of climate. When assessing how well a tree species might cope with future climate conditions, it is important to consider more than just temperature. While mean annual temperature (MAT) gives a good indication of general warmth, it does not reflect how much water is available to the plant — a key factor in its survival and growth.

To provide a fuller picture, we also include the Climatic Moisture Index (CMI), which reflects the balance between rainfall and evaporation. CMI helps us understand how dry or moist a place is likely to be, both now and in the future. By using both MAT and CMI together, we gain a much clearer understanding of where a species can thrive. This is especially important as climate change is expected to bring not just warmer temperatures but also changes in water availability, including more frequent droughts. An example of a species distribution model can be seen for *Betula pendula* (Figure 6).

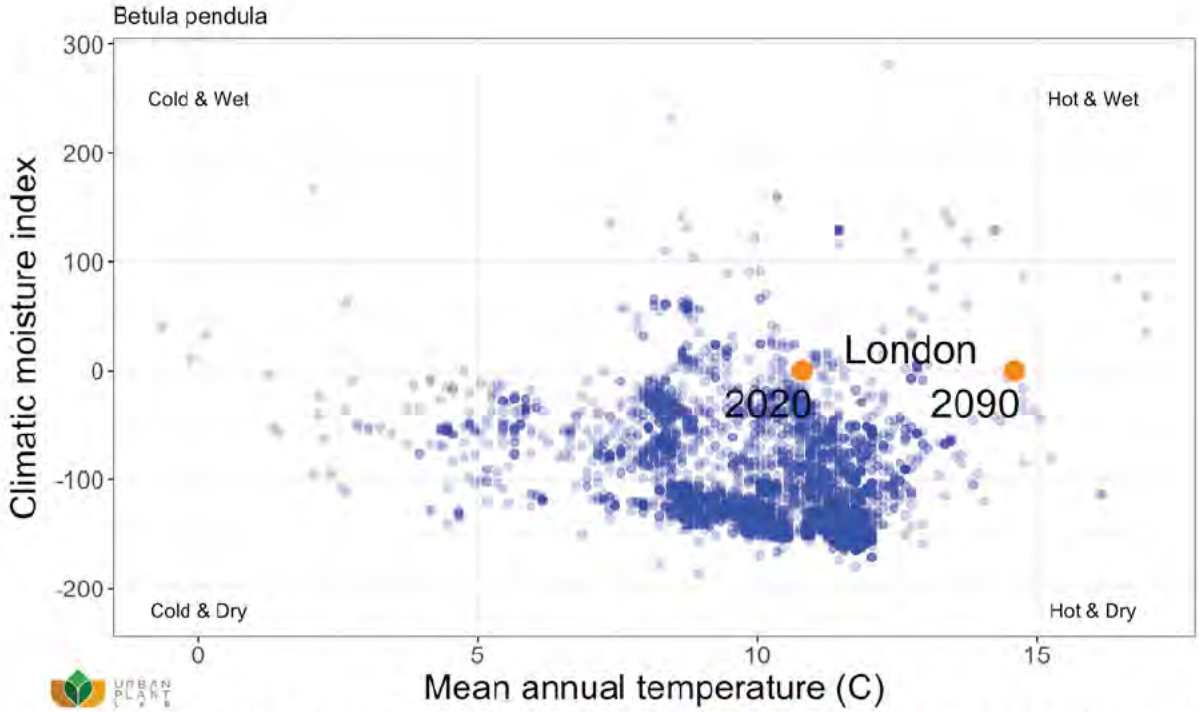

Figure 6: Example of a species distribution model for *Betula pendula*. Each blue point represents a population of the species in relation to its climate. The larger orange points represent the current and future climate of London in relation to the population of *Betula pendula*.

Based on this species distribution modelling it is possible to score the likely vulnerability to future climate using a four-point scoring system (Table 2) that can be integrated into the composite climate resilience score.

Table 2: Scoring system associated with the species distribution modelling.

Species distribution model score	Narrative description of score
1 Point Sensitive to future climate	This species is suited to today's climate but its current distribution does not occur in regions within a future climate analogue. Therefore, as a species, it is likely to have very low resilience to future climate scenarios and targeted ecotype and provenance selection is not likely to yield suitable plant material for successful cultivars. Examples of these species currently in the landscape may require more intensive management to mitigate abiotic stress and maintain tree performance.
2 Points Moderately sensitive to future climate	This species is suited to the today's climate but only a very minor percentage of the species' current distribution occurs in regions within a future climate analogue. Therefore, it is likely to have low resilience to future climate. With very focused effort, targeted ecotype and provenance selection may yield suitable plant material for successful cultivars. Examples of these species currently in the landscape may require more intensive management to mitigate abiotic stress and maintain tree performance.

3 Points Moderately resilient to future climate	This species is suited to the today's climate and its current distribution overlaps with the future climate analogue at its margin. Therefore, it is likely to have some resilience to future climate. With focused effort, targeted ecotype and provenance selection is likely to yield plant material that will be suitable for future climate scenarios.
4 Points Resilient to future climate	This species is suited to the today's climate and its current distribution substantially overlaps with the future climate analogue. This species is likely to have good resilience to future climate. Provenance and ecotype selection is likely to optimise future climate compatibility.

The 43 focus species (actually [TaxonName]); 5 genus-level, 38 species-level) represent 76% of London's public realm trees.

Analysis was conducted for Inner and Greater London 'sites'. Differences between these sites are as a function of the urban heat island effect (Figure 3). Of the 76% of public realm trees evaluated, Greater London is assessed to have 35% of trees with high resilience, 64% with moderate resilience and 1% with low resilience to future climate. Inner London is assessed to have 13% of trees with high resilience, 80% with moderate resilience and 7% with low resilience to future climate (Figure 7).

Figure 7: Summary of the percentage of trees in each resilience class for the two 'sites' evaluated. Green = High resilience, Amber = Moderate resilience, Red = Low resilience.

31% are estimated to have a low climate resilience rating, 62% are estimated to have a medium climate rating and only 7% are estimated to have a high climate resilience rating (Table 3).

Table 3: Outcome summaries, with confidence statements for the focus species of this study. Species were given a low confidence score when the cluster score for a trait had to be estimated, rather than based on data from the scientific literature. See also Table A2 in appendix which includes individual trait cluster and species distribution modelling scores.

Species/Genera	Outcome (Inner London)	Outcome (Greater London)	Confidence in outcome	Percentage of public realm trees	Tree Count
Acer	Moderate resilience	Moderate resilience	Low	0.66	7179
Acer campestre	Moderate resilience	Moderate resilience	High	2.76	30041
Acer platanoides	Moderate resilience	High resilience	High	4.69	51038
Acer pseudoplatanus	Moderate resilience	Moderate resilience	High	4.36	47396
Aesculus hippocastanum	Low resilience	Moderate resilience	High	2.08	22610
Alnus glutinosa	Moderate resilience	Moderate resilience	High	0.51	5506
Betula	Moderate resilience	Moderate resilience	Low	1.02	11050
Betula pendula	Moderate resilience	Moderate resilience	High	2.70	29396
Betula pubescens	Moderate resilience	Moderate resilience	High	0.37	4018
Carpinus betulus	Moderate resilience	Moderate resilience	High	3.10	33737
Corylus avellana	Moderate resilience	Moderate resilience	High	0.20	2189
Crataegus laevigata	Moderate resilience	High resilience	Low	0.29	3180
Crataegus monogyna	Moderate resilience	High resilience	High	2.23	24254
Fagus sylvatica	Moderate resilience	High resilience	High	0.84	9099
Fraxinus	High resilience	High resilience	Low	0.63	6902
Fraxinus excelsior	High resilience	High resilience	High	4.52	49190
Ilex aquifolium	High resilience	High resilience	High	1.21	13201
Juniperus communis	High resilience	High resilience	Low	0.01	146
Malus	Moderate resilience	Moderate resilience	Low	2.29	24912
Malus sylvestris	Moderate resilience	Moderate resilience	Low	0.19	2062
Pinus sylvestris	Moderate resilience	High resilience	High	0.51	5530
Platanus x hispanica	Moderate resilience	Moderate resilience	High	6.78	73688

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Populus nigra	Low resilience	Low resilience	High	0.76	8241
Populus tremula	Moderate resilience	Moderate resilience	High	0.15	1609
Prunus	Moderate resilience	Moderate resilience	Low	7.45	81045
Prunus avium	Low resilience	Moderate resilience	High	2.58	28039
Prunus cerasifera	Moderate resilience	High resilience	Low	1.56	16937
Prunus padus	Moderate resilience	Moderate resilience	Low	0.40	4387
Pyrus	Moderate resilience	Moderate resilience	Low	1.86	20236
Quercus petraea	High resilience	High resilience	High	0.03	295
Quercus robur	Moderate resilience	High resilience	High	5.76	62628
Robinia pseudoacacia	Moderate resilience	Moderate resilience	High	1.09	11839
Salix caprea	Moderate resilience	Moderate resilience	High	0.26	2839
Salix pentandra	Low resilience	Moderate resilience	Low	0.00	12
Sorbus	Moderate resilience	Moderate resilience	Low	0.71	7756
Sorbus aria	High resilience	High resilience	Low	0.96	10461
Sorbus aucuparia	High resilience	High resilience	High	1.41	15299
Sorbus torminalis	Moderate resilience	High resilience	High	0.06	669
Taxus baccata	High resilience	High resilience	High	0.76	8280
Tilia	Moderate resilience	Moderate resilience	Low	2.22	24154
Tilia cordata	Moderate resilience	Moderate resilience	High	1.54	16699
Tilia platyphyllos	Moderate resilience	High resilience	High	0.84	9093
Tilia x europaea	Moderate resilience	Moderate resilience	High	3.60	39142
Total percentage				**76**	**825984**

Next steps

Final reporting will occur at the end of September 2025. This makes any outstanding data that could be included in this analysis an urgent priority. Data from the few missing local authorities/borough councils is unlikely to change the species composition of the analysis, but it will change the proportions within each resilience class.

London wide tree demographic analysis is made much more efficient and robust if a shared data standard can be agreed upon. Work to develop consensus around a new Greater London Authority tree data standard should be explored. As a minimum a nomenclature standard, following, for example, the taxonomic backbone of *Plants of the world online*, should be agree.

The *Urban Plant Lab* team will seek to further reduce incidence of low confidence scores within the data.

Following discussion with advisory groups and stakeholders, strategic management recommendations and key objectives will be presented in the final report. This will include species recommendations for future planting and recommendations that relate to the current tree stock.

Appendix 1 – Supplementary Data

Table A1: List of tree species in London's public realm trees with relative counts and percentage data. N.B. Some of the 'Species' are recorded as Genus, but these have been preserved as 'Species' to give a more accurate summary of the dataset.

Botanical Family [TaxonFamil]	Genus [TaxonGenus}	Species [TaxonName]	Count	Percentage
Adoxaceae	*Sambucus*	*Sambucus*	103	0.00969653
Adoxaceae	*Sambucus*	*Sambucus nigra*	6226	0.5861221
Altingiaceae	*Liquidambar*	*Liquidambar*	119	0.01120278
Altingiaceae	*Liquidambar*	*Liquidambar styraciflua*	9270	0.87268743
Anacardiaceae	*Rhus*	*Rhus*	74	0.00696644
Anacardiaceae	*Rhus*	*Rhus typhina*	242	0.02278213
Aquifoliaceae	*Ilex*	*Ilex*	1301	0.12247749
Aquifoliaceae	*Ilex*	*Ilex aquifolium*	12732	1.1986037
Aquifoliaceae	*Ilex*	*Ilex x altaclerensis*	867	0.08162028
Araliaceae	*Aralia*	*Aralia*	6	0.00056485
Araliaceae	*Aralia*	*Aralia elata*	10	0.00094141
Araucariaceae	*Araucaria*	*Araucaria*	1	9.41E-05
Araucariaceae	*Araucaria*	*Araucaria araucana*	92	0.00866098
Araucariaceae	*Wollemia*	*Wollemia nobilis*	8	0.00075313
Arecaceae	*Phoenix*	*Phoenix dactylifera*	3	0.00028242
Arecaceae	*Trachycarpus*	*Trachycarpus fortunei*	93	0.00875512
Asparagaceae	*Yucca*	*Yucca*	4	0.00037656
Asparagaceae	*Yucca*	*Yucca filamentosa*	7	0.00065899
Betulaceae	*Alnus*	*Alnus*	1031	0.09705941
Betulaceae	*Alnus*	*Alnus cordata*	4978	0.46863409

Betulaceae	*Alnus*	*Alnus glutinosa*	5374	0.50591394
Betulaceae	*Alnus*	*Alnus incana*	2120	0.199579
Betulaceae	*Alnus*	*Alnus rubra*	122	0.01148521
Betulaceae	*Alnus*	*Alnus viridis*	20	0.00188282
Betulaceae	*Betula*	*Betula*	10353	0.97464217
Betulaceae	*Betula*	*Betula alba*	24	0.00225938
Betulaceae	*Betula*	*Betula albosinensis*	1590	0.14968425
Betulaceae	*Betula*	*Betula jacquemontii*	2187	0.20588645
Betulaceae	*Betula*	*Betula lenta*	26	0.00244767
Betulaceae	*Betula*	*Betula maximowicziana*	82	0.00771957
Betulaceae	*Betula*	*Betula nana*	1	9.41E-05
Betulaceae	*Betula*	*Betula nigra*	1196	0.11259268
Betulaceae	*Betula*	*Betula papyrifera*	1781	0.16766519
Betulaceae	*Betula*	*Betula pendula*	28640	2.69619934
Betulaceae	*Betula*	*Betula pubescens*	3953	0.37213952
Betulaceae	*Betula*	*Betula utilis*	6789	0.63912351
Betulaceae	*Carpinus*	*Carpinus*	262	0.02466495
Betulaceae	*Carpinus*	*Carpinus betulus*	33136	3.11945745
Betulaceae	*Corylus*	*Corylus*	316	0.02974857
Betulaceae	*Corylus*	*Corylus avellana*	2152	0.20259151
Betulaceae	*Corylus*	*Corylus colurna*	5279	0.49697054
Betulaceae	*Corylus*	*Corylus maxima*	30	0.00282423
Betulaceae	*Ostrya*	*Ostrya*	15	0.00141212
Betulaceae	*Ostrya*	*Ostrya carpinifolia*	635	0.05977956
Bignoniaceae	*Catalpa*	*Catalpa*	19	0.00178868
Bignoniaceae	*Catalpa*	*Catalpa bignonioides*	1510	0.14215297
Brassicaceae	*Camelina*	*Camelina*	24	0.00225938

Buxaceae	*Buxus*	*Buxus*	4	0.00037656
Buxaceae	*Buxus*	*Buxus sempervirens*	212	0.0199579
Celastraceae	*Euonymus*	*Euonymus*	10	0.00094141
Cephalotaxaceae	*Cephalotaxus*	*Cephalotaxus*	8	0.00075313
Cephalotaxaceae	*Cephalotaxus*	*Cephalotaxus fortunei*	3	0.00028242
Cornaceae	*Cornus*	*Cornus*	255	0.02400596
Cornaceae	*Cornus*	*Cornus alba*	45	0.00423635
Cornaceae	*Cornus*	*Cornus alternifolia*	2	0.00018828
Cornaceae	*Cornus*	*Cornus florida*	8	0.00075313
Cornaceae	*Cornus*	*Cornus kousa*	112	0.0105438
Cornaceae	*Cornus*	*Cornus mas*	483	0.04547012
Cornaceae	*Cornus*	*Cornus sanguinea*	51	0.00480119
Cornaceae	*Davidia*	*Davidia involucrata*	139	0.0130856
Cupressaceae	*Austrocedrus*	*Austrocedrus chilensis*	1	9.41E-05
Cupressaceae	*Calocedrus*	*Calocedrus decurrens*	84	0.00790785
Cupressaceae	*Chamaecyparis*	*Chamaecyparis*	823	0.07747807
Cupressaceae	*Chamaecyparis*	*Chamaecyparis lawsoniana*	7619	0.71726057
Cupressaceae	*Chamaecyparis*	*Chamaecyparis obtusa*	43	0.00404806
Cupressaceae	*Chamaecyparis*	*Chamaecyparis pisifera*	4	0.00037656
Cupressaceae	*Cryptomeria*	*Cryptomeria*	2	0.00018828
Cupressaceae	*Cryptomeria*	*Cryptomeria japonica*	81	0.00762542
Cupressaceae	*Cupressus*	*Cupressus*	3663	0.34483862
Cupressaceae	*Cupressus*	*Cupressus arizonica*	73	0.0068723
Cupressaceae	*Cupressus*	*Cupressus macrocarpa*	639	0.06015612
Cupressaceae	*Cupressus*	*Cupressus sempervirens*	52	0.00489533
Cupressaceae	*Cupressus*	*X Cuprocyparis leylandi*	4963	0.46722197
Cupressaceae	*Juniperus*	*Juniperus*	102	0.00960239

Cupressaceae	*Juniperus*	*Juniperus chinensis*	25	0.00235353
Cupressaceae	*Juniperus*	*Juniperus communis*	132	0.01242662
Cupressaceae	*Juniperus*	*Juniperus virginiana*	11	0.00103555
Cupressaceae	*Metasequoia*	*Metasequoia*	20	0.00188282
Cupressaceae	*Metasequoia*	*Metasequoia glyptostroboides*	1336	0.12577243
Cupressaceae	*Platycladus*	*Platycladus orientalis*	19	0.00178868
Cupressaceae	*Sequoia*	*Sequoia*	4	0.00037656
Cupressaceae	*Sequoia*	*Sequoia sempervirens*	167	0.01572155
Cupressaceae	*Sequoiadendron*	*Sequoiadendron giganteum*	485	0.0456584
Cupressaceae	*Taxodium*	*Taxodium distichum*	488	0.04594083
Cupressaceae	*Thuja*	*Thuja*	82	0.00771957
Cupressaceae	*Thuja*	*Thuja occidentalis*	16	0.00150626
Cupressaceae	*Thuja*	*Thuja plicata*	1444	0.13593966
Cupressaceae	*Thujopsis*	*Thujopsis dolabrata*	7	0.00065899
Cupressaceae	*Xanthocyparis*	*Xanthocyparis nootkatensis*	23	0.00216524
Dicksoniaceae	*Dicksonia*	*Dicksonia antarctica*	4	0.00037656
Elaeagnaceae	*Elaeagnus*	*Elaeagnus*	8	0.00075313
Elaeagnaceae	*Elaeagnus*	*Elaeagnus angustifolia*	11	0.00103555
Elaeagnaceae	*Hippophae*	*Hippophae*	55	0.00517776
Elaeagnaceae	*Hippophae*	*Hippophae rhamnoides*	33	0.00310665
Ericaceae	*Arbutus*	*Arbutus*	2	0.00018828
Ericaceae	*Arbutus*	*Arbutus unedo*	246	0.0231587
Ericaceae	*Arbutus*	*Arbutus x andrachnoides*	12	0.00112969
Fabaceae	*Acacia*	*Acacia*	114	0.01073208
Fabaceae	*Acacia*	*Acacia dealbata*	17	0.0016004
Fabaceae	*Acacia*	*Acacia melanoxylon*	4	0.00037656
Fabaceae	*Caragana*	*Caragana arborescens*	2	0.00018828

Fabaceae	*Cercis*	*Cercis*	73	0.0068723
Fabaceae	*Cercis*	*Cercis siliquastrum*	640	0.06025026
Fabaceae	*Gleditsia*	*Gleditsia*	113	0.01063794
Fabaceae	*Gleditsia*	*Gleditsia triacanthos*	3817	0.35933634
Fabaceae	*Laburnum*	*Laburnum*	241	0.02268799
Fabaceae	*Laburnum*	*Laburnum alpinum*	1	9.41E-05
Fabaceae	*Laburnum*	*Laburnum anagyroides*	734	0.06909952
Fabaceae	*Laburnum*	*Laburnum x watereri*	178	0.0167571
Fabaceae	*Robinia*	*Robinia*	458	0.0431166
Fabaceae	*Robinia*	*Robinia pseudoacacia*	11605	1.09250675
Fabaceae	*Ulex*	*Ulex europaeus*	1	9.41E-05
Fagaceae	*Castanea*	*Castanea*	51	0.00480119
Fagaceae	*Castanea*	*Castanea sativa*	5145	0.48435564
Fagaceae	*Fagus*	*Fagus*	143	0.01346217
Fagaceae	*Fagus*	*Fagus orientalis*	12	0.00112969
Fagaceae	*Fagus*	*Fagus sylvatica*	8959	0.84340956
Fagaceae	*Quercus*	*Quercus*	4233	0.39849902
Fagaceae	*Quercus*	*Quercus alba*	2	0.00018828
Fagaceae	*Quercus*	*Quercus castaneifolia*	61	0.0057426
Fagaceae	*Quercus*	*Quercus cerris*	3446	0.32441002
Fagaceae	*Quercus*	*Quercus coccinea*	311	0.02927786
Fagaceae	*Quercus*	*Quercus frainetto*	158	0.01487428
Fagaceae	*Quercus*	*Quercus ilex*	2865	0.26971407
Fagaceae	*Quercus*	*Quercus imbricaria*	1	9.41E-05
Fagaceae	*Quercus*	*Quercus palustris*	910	0.08566834
Fagaceae	*Quercus*	*Quercus petraea*	293	0.02758332
Fagaceae	*Quercus*	*Quercus phellos*	27	0.00254181

Fagaceae	*Quercus*	*Quercus phillyreoides*	1	9.41E-05
Fagaceae	*Quercus*	*Quercus pubescens*	1	9.41E-05
Fagaceae	*Quercus*	*Quercus robur*	61724	5.81076145
Fagaceae	*Quercus*	*Quercus rubra*	2373	0.22339668
Fagaceae	*Quercus*	*Quercus suber*	94	0.00884926
Fagaceae	*Quercus*	*Quercus velutina*	2	0.00018828
Fagaceae	*Quercus*	*Quercus x crenata*	44	0.00414221
Fagaceae	*Quercus*	*Quercus x turneri*	30	0.00282423
Garryaceae	*Garrya*	*Garrya elliptica*	13	0.00122383
Ginkgoaceae	*Ginkgo*	*Ginkgo biloba*	5052	0.47560053
Grossulariaceae	*Ribes*	*Ribes speciosum*	2	0.00018828
Juglandaceae	*Carya*	*Carya*	129	0.01214419
Juglandaceae	*Carya*	*Carya cordiformis*	2	0.00018828
Juglandaceae	*Carya*	*Carya illinoensis*	2	0.00018828
Juglandaceae	*Carya*	*Carya ovata*	8	0.00075313
Juglandaceae	*Juglans*	*Juglans*	30	0.00282423
Juglandaceae	*Juglans*	*Juglans nigra*	505	0.04754122
Juglandaceae	*Juglans*	*Juglans regia*	1397	0.13151503
Juglandaceae	*Pterocarya*	*Pterocarya*	7	0.00065899
Juglandaceae	*Pterocarya*	*Pterocarya fraxinifolia*	353	0.03323179
Juglandaceae	*Pterocarya*	*Pterocarya x rehderiana*	11	0.00103555
Lamiaceae	*Clerodendrum*	*Clerodendrum trichotomum*	202	0.01901649
Lauraceae	*Laurus*	*Laurus*	78	0.007343
Lauraceae	*Laurus*	*Laurus nobilis*	1024	0.09640042
Lauraceae	*Persea*	*Persea americana*	2	0.00018828
Lauraceae	*Umbellularia*	*Umbellularia californica*	4	0.00037656
Magnoliaceae	*Liriodendron*	*Liriodendron*	1	9.41E-05

Magnoliaceae	*Liriodendron*	*Liriodendron tulipifera*	2439	0.22960999
Magnoliaceae	*Magnolia*	*Magnolia*	4024	0.37882354
Magnoliaceae	*Magnolia*	*Magnolia acuminata*	5	0.00047071
Magnoliaceae	*Magnolia*	*Magnolia grandiflora*	31	0.00291837
Malvaceae	*Hibiscus*	*Hibiscus*	336	0.03163139
Malvaceae	*Hibiscus*	*Hibiscus syriacus*	105	0.00988481
Malvaceae	*Tilia*	*Tilia*	22615	2.12899958
Malvaceae	*Tilia*	*Tilia americana*	178	0.0167571
Malvaceae	*Tilia*	*Tilia cordata*	16602	1.56292952
Malvaceae	*Tilia*	*Tilia platyphyllos*	9082	0.85498891
Malvaceae	*Tilia*	*Tilia tomentosa*	1112	0.10468483
Malvaceae	*Tilia*	*Tilia x euchlora*	4962	0.46712783
Malvaceae	*Tilia*	*Tilia x europaea*	38237	3.59967088
Moraceae	*Ficus*	*Ficus*	8	0.00075313
Moraceae	*Ficus*	*Ficus carica*	407	0.0383154
Moraceae	*Morus*	*Morus*	13	0.00122383
Moraceae	*Morus*	*Morus alba*	319	0.03003099
Moraceae	*Morus*	*Morus nigra*	380	0.03577359
Myrtaceae	*Eucalyptus*	*Eucalyptus*	210	0.01976962
Myrtaceae	*Eucalyptus*	*Eucalyptus coccifera*	23	0.00216524
Myrtaceae	*Eucalyptus*	*Eucalyptus globulus*	4	0.00037656
Myrtaceae	*Eucalyptus*	*Eucalyptus gunnii*	536	0.0504596
Myrtaceae	*Eucalyptus*	*Eucalyptus niphophila*	35	0.00329494
Myrtaceae	*Eucalyptus*	*Eucalyptus pauciflora*	2	0.00018828
NULL	*Acacia*	*Acacia pravissima*	2	0.00018828
NULL	*Broussonetia*	*Broussonetia papyrifera*	22	0.0020711
NULL	*Celtis*	*Celtis australis*	1439	0.13546895

NULL	*Chitalpa*	*Chitalpa taschkentensis*	158	0.01487428
NULL	*Eucalyptus*	*Eucalyptus perriniana*	1	9.41E-05
NULL	*Mespilus*	*Mespilus germanica*	1	9.41E-05
NULL	*Nyssa*	*Nyssa sylvatica*	143	0.01346217
NULL	*Olea*	*Olea europaea*	338	0.03181967
NULL	*Prunus*	*Prunus maackii*	488	0.04594083
NULL	*Sophora*	*Sophora microphylla*	1	9.41E-05
NULL	*Sophora*	*Sophora tetraptera*	12	0.00112969
NULL	*Styphnolobium*	*Styphnolobium japonicum*	34	0.0032008
NULL	*Styrax*	*Styrax japonicus*	7	0.00065899
Nothofagaceae	*Nothofagus*	*Nothofagus*	26	0.00244767
Nothofagaceae	*Nothofagus*	*Nothofagus alpina*	11	0.00103555
Nothofagaceae	*Nothofagus*	*Nothofagus antarctica*	148	0.01393287
Nothofagaceae	*Nothofagus*	*Nothofagus dombeyi*	17	0.0016004
Nothofagaceae	*Nothofagus*	*Nothofagus obliqua*	66	0.00621331
Oleaceae	*Fraxinus*	*Fraxinus*	6593	0.62067187
Oleaceae	*Fraxinus*	*Fraxinus americana*	349	0.03285522
Oleaceae	*Fraxinus*	*Fraxinus angustifolia*	1306	0.1229482
Oleaceae	*Fraxinus*	*Fraxinus excelsior*	48324	4.54927154
Oleaceae	*Fraxinus*	*Fraxinus latifolia*	19	0.00178868
Oleaceae	*Fraxinus*	*Fraxinus ornus*	2230	0.20993452
Oleaceae	*Fraxinus*	*Fraxinus pennsylvanica*	67	0.00630745
Oleaceae	*Fraxinus*	*Fraxinus velutina*	6	0.00056485
Oleaceae	*Ligustrum*	*Ligustrum*	2091	0.19684891
Oleaceae	*Ligustrum*	*Ligustrum lucidum*	1146	0.10788563
Oleaceae	*Syringa*	*Syringa*	73	0.0068723
Oleaceae	*Syringa*	*Syringa vulgaris*	649	0.06109753

Paulowniaceae	*Paulownia*	*Paulownia tomentosa*	543	0.05111858
Pinaceae	*Abies*	*Abies*	112	0.0105438
Pinaceae	*Abies*	*Abies alba*	71	0.00668401
Pinaceae	*Abies*	*Abies cephalonica*	3	0.00028242
Pinaceae	*Abies*	*Abies concolor*	1	9.41E-05
Pinaceae	*Abies*	*Abies delavayi*	1	9.41E-05
Pinaceae	*Abies*	*Abies fraseri*	24	0.00225938
Pinaceae	*Abies*	*Abies grandis*	79	0.00743714
Pinaceae	*Abies*	*Abies koreana*	9	0.00084727
Pinaceae	*Abies*	*Abies lasiocarpa*	6	0.00056485
Pinaceae	*Abies*	*Abies nordmanniana*	16	0.00150626
Pinaceae	*Abies*	*Abies procera*	35	0.00329494
Pinaceae	*Cedrus*	*Cedrus*	261	0.02457081
Pinaceae	*Cedrus*	*Cedrus atlantica*	1176	0.11070986
Pinaceae	*Cedrus*	*Cedrus brevifolia*	9	0.00084727
Pinaceae	*Cedrus*	*Cedrus deodara*	712	0.06702842
Pinaceae	*Cedrus*	*Cedrus libani*	425	0.04000994
Pinaceae	*Larix*	*Larix*	110	0.01035551
Pinaceae	*Larix*	*Larix decidua*	371	0.03492633
Pinaceae	*Larix*	*Larix kaempferi*	49	0.00461291
Pinaceae	*Larix*	*Larix x marschlinsii*	42	0.00395392
Pinaceae	*Picea*	*Picea*	66	0.00621331
Pinaceae	*Picea*	*Picea abies*	485	0.0456584
Pinaceae	*Picea*	*Picea breweriana*	12	0.00112969
Pinaceae	*Picea*	*Picea glauca*	10	0.00094141
Pinaceae	*Picea*	*Picea obovata*	1	9.41E-05
Pinaceae	*Picea*	*Picea omorika*	56	0.0052719

Pinaceae	*Picea*	*Picea orientalis*	2	0.00018828
Pinaceae	*Picea*	*Picea pungens*	45	0.00423635
Pinaceae	*Picea*	*Picea sitchensis*	10	0.00094141
Pinaceae	*Picea*	*Picea smithiana*	4	0.00037656
Pinaceae	*Pinus*	*Pinus*	1023	0.09630628
Pinaceae	*Pinus*	*Pinus cembra*	3	0.00028242
Pinaceae	*Pinus*	*Pinus contorta*	7	0.00065899
Pinaceae	*Pinus*	*Pinus mugo*	32	0.00301251
Pinaceae	*Pinus*	*Pinus muricata*	1	9.41E-05
Pinaceae	*Pinus*	*Pinus nigra*	2706	0.25474565
Pinaceae	*Pinus*	*Pinus peuce*	6	0.00056485
Pinaceae	*Pinus*	*Pinus pinaster*	21	0.00197696
Pinaceae	*Pinus*	*Pinus pinea*	254	0.02391182
Pinaceae	*Pinus*	*Pinus ponderosa*	13	0.00122383
Pinaceae	*Pinus*	*Pinus radiata*	96	0.00903754
Pinaceae	*Pinus*	*Pinus strobus*	56	0.0052719
Pinaceae	*Pinus*	*Pinus sylvestris*	5459	0.51391593
Pinaceae	*Pinus*	*Pinus wallichiana*	103	0.00969653
Pinaceae	*Pinus*	*Pinus x holfordiana*	7	0.00065899
Pinaceae	*Pseudotsuga*	*Pseudotsuga menziesii*	59	0.00555432
Pinaceae	*Tsuga*	*Tsuga*	2	0.00018828
Pinaceae	*Tsuga*	*Tsuga canadensis*	3	0.00028242
Pinaceae	*Tsuga*	*Tsuga heterophylla*	11	0.00103555
Platanaceae	*Platanus*	*Platanus occidentalis*	15	0.00141212
Platanaceae	*Platanus*	*Platanus orientalis*	819	0.07710151
Platanaceae	*Platanus*	*Platanus x hispanica*	71980	6.77627194
Rhamnaceae	*Rhamnus*	*Rhamnus*	4	0.00037656

Rosaceae	*Amelanchier*	*Amelanchier*	7449	0.70125659
Rosaceae	*Amelanchier*	*Amelanchier lamarckii*	3211	0.30228687
Rosaceae	*Amelanchier*	*Amelanchier ovalis*	58	0.00546018
Rosaceae	*Cotoneaster*	*Cotoneaster frigidus*	386	0.03633844
Rosaceae	*Crataegus*	*Crataegus*	4721	0.44443984
Rosaceae	*Crataegus*	*Crataegus coccinea*	6	0.00056485
Rosaceae	*Crataegus*	*Crataegus crus-galli*	985	0.09272892
Rosaceae	*Crataegus*	*Crataegus laevigata*	3156	0.29710912
Rosaceae	*Crataegus*	*Crataegus mollis*	26	0.00244767
Rosaceae	*Crataegus*	*Crataegus monogyna*	23959	2.25552514
Rosaceae	*Crataegus*	*Crataegus persimilis*	2985	0.281011
Rosaceae	*Crataegus*	*Crataegus punctata*	3	0.00028242
Rosaceae	*Crataegus*	*Crataegus succulenta*	8	0.00075313
Rosaceae	*Crataegus*	*Crataegus x lavallei*	1575	0.14827214
Rosaceae	*Cydonia*	*Cydonia oblonga*	73	0.0068723
Rosaceae	*Eriobotrya*	*Eriobotrya japonica*	113	0.01063794
Rosaceae	*Malus*	*Malus*	24047	2.26380955
Rosaceae	*Malus*	*Malus baccata*	594	0.05591978
Rosaceae	*Malus*	*Malus floribunda*	605	0.05695533
Rosaceae	*Malus*	*Malus hupehensis*	200	0.01882821
Rosaceae	*Malus*	*Malus niedzwetzkyana*	1	9.41E-05
Rosaceae	*Malus*	*Malus prunifolia*	41	0.00385978
Rosaceae	*Malus*	*Malus pumila*	1659	0.15617998
Rosaceae	*Malus*	*Malus sieboldii*	11	0.00103555
Rosaceae	*Malus*	*Malus sylvestris*	1979	0.18630511
Rosaceae	*Malus*	*Malus x purpurea*	1044	0.09828324
Rosaceae	*Malus*	*Malus x robusta*	32	0.00301251

Rosaceae	*Mespilus*	*Mespilus*	334	0.03144311
Rosaceae	*Mespilus*	*Mespilus germanica*	199	0.01873407
Rosaceae	*Prunus*	*Prunus*	79322	7.46745544
Rosaceae	*Prunus*	*Prunus armeniaca*	2	0.00018828
Rosaceae	*Prunus*	*Prunus avium*	27220	2.56251906
Rosaceae	*Prunus*	*Prunus cerasifera*	16458	1.54937321
Rosaceae	*Prunus*	*Prunus cerasus*	45	0.00423635
Rosaceae	*Prunus*	*Prunus domestica*	1417	0.13339785
Rosaceae	*Prunus*	*Prunus dulcis*	477	0.04490528
Rosaceae	*Prunus*	*Prunus incisa*	74	0.00696644
Rosaceae	*Prunus*	*Prunus laurocerasus*	1728	0.16267571
Rosaceae	*Prunus*	*Prunus lusitanica*	740	0.06966437
Rosaceae	*Prunus*	*Prunus padus*	4305	0.40527717
Rosaceae	*Prunus*	*Prunus persica*	24	0.00225938
Rosaceae	*Prunus*	*Prunus pissardii*	1665	0.15674483
Rosaceae	*Prunus*	*Prunus serotina*	14	0.00131797
Rosaceae	*Prunus*	*Prunus serrulata*	5333	0.50205416
Rosaceae	*Prunus*	*Prunus spinosa*	1825	0.17180739
Rosaceae	*Prunus*	*Prunus x fruticans*	2157	0.20306222
Rosaceae	*Pyrus*	*Pyrus*	19726	1.85702612
Rosaceae	*Pyrus*	*Pyrus calleryana*	1439	0.13546895
Rosaceae	*Pyrus*	*Pyrus communis*	1567	0.14751901
Rosaceae	*Pyrus*	*Pyrus cordata*	7	0.00065899
Rosaceae	*Pyrus*	*Pyrus pyraster*	5	0.00047071
Rosaceae	*Pyrus*	*Pyrus salicifolia*	241	0.02268799
Rosaceae	*Sorbaria*	*Sorbaria tomentosa*	2	0.00018828
Rosaceae	*Sorbus*	*Sorbus*	7566	0.7122711

Rosaceae	*Sorbus*	*Sorbus 'Joseph Rock'*	114	0.01073208
Rosaceae	*Sorbus*	*Sorbus aria*	10249	0.9648515
Rosaceae	*Sorbus*	*Sorbus aucuparia*	15056	1.41738747
Rosaceae	*Sorbus*	*Sorbus commixta*	466	0.04386972
Rosaceae	*Sorbus*	*Sorbus domestica*	140	0.01317975
Rosaceae	*Sorbus*	*Sorbus glabriscula*	238	0.02240557
Rosaceae	*Sorbus*	*Sorbus intermedia*	8771	0.82571105
Rosaceae	*Sorbus*	*Sorbus latifolia*	167	0.01572155
Rosaceae	*Sorbus*	*Sorbus mougeotii*	22	0.0020711
Rosaceae	*Sorbus*	*Sorbus sargentiana*	17	0.0016004
Rosaceae	*Sorbus*	*Sorbus thibetica*	14	0.00131797
Rosaceae	*Sorbus*	*Sorbus torminalis*	663	0.06241551
Rosaceae	*Sorbus*	*Sorbus vilmorinii*	12	0.00112969
Rosaceae	*Sorbus*	*Sorbus x thuringiaca*	1276	0.12012396
Rutaceae	*Citrus*	*Citrus*	3	0.00028242
Rutaceae	*Citrus*	*Citrus trifoliata*	3	0.00028242
Salicaceae	*Populus*	*Populus*	5413	0.50958544
Salicaceae	*Populus*	*Populus alba*	2550	0.24005965
Salicaceae	*Populus*	*Populus balsamifera*	641	0.06034441
Salicaceae	*Populus*	*Populus canescens*	257	0.02419425
Salicaceae	*Populus*	*Populus deltoides*	1	9.41E-05
Salicaceae	*Populus*	*Populus laurifolia*	3	0.00028242
Salicaceae	*Populus*	*Populus nigra*	8070	0.75971818
Salicaceae	*Populus*	*Populus tremula*	1593	0.14996667
Salicaceae	*Populus*	*Populus tremuloides*	21	0.00197696
Salicaceae	*Populus*	*Populus trichocarpa*	61	0.0057426
Salicaceae	*Populus*	*Populus x berolinensis*	1	9.41E-05

Salicaceae	*Populus*	*Populus x canadensis*	968	0.09112853
Salicaceae	*Populus*	*Populus x candicans*	74	0.00696644
Salicaceae	*Populus*	*Populus x canescens*	379	0.03567945
Salicaceae	*Populus*	*Populus x jackii*	30	0.00282423
Salicaceae	*Populus*	*Populus yunnanensis*	1	9.41E-05
Salicaceae	*Salix*	*Salix*	4555	0.42881243
Salicaceae	*Salix*	*Salix alba*	2594	0.24420185
Salicaceae	*Salix*	*Salix babylonica*	722	0.06796983
Salicaceae	*Salix*	*Salix caprea*	2813	0.26481874
Salicaceae	*Salix*	*Salix cinerea*	61	0.0057426
Salicaceae	*Salix*	*Salix daphnoides*	9	0.00084727
Salicaceae	*Salix*	*Salix matsudana*	242	0.02278213
Salicaceae	*Salix*	*Salix pentandra*	12	0.00112969
Salicaceae	*Salix*	*Salix viminalis*	2	0.00018828
Salicaceae	*Salix*	*Salix x fragilis*	2439	0.22960999
Salicaceae	*Salix*	*Salix x sepulcralis*	849	0.07992574
Sapindaceae	*Acer*	*Acer*	6933	0.65267982
Sapindaceae	*Acer*	*Acer campestre*	29259	2.75447264
Sapindaceae	*Acer*	*Acer cappadocicum*	1370	0.12897322
Sapindaceae	*Acer*	*Acer davidii*	279	0.02626535
Sapindaceae	*Acer*	*Acer griseum*	157	0.01478014
Sapindaceae	*Acer*	*Acer hersii*	4	0.00037656
Sapindaceae	*Acer*	*Acer japonicum*	59	0.00555432
Sapindaceae	*Acer*	*Acer macrophyllum*	4	0.00037656
Sapindaceae	*Acer*	*Acer monspessulanum*	40	0.00376564
Sapindaceae	*Acer*	*Acer negundo*	2101	0.19779032
Sapindaceae	*Acer*	*Acer opalus*	9	0.00084727

Sapindaceae	*Acer*	*Acer palmatum*	361	0.03398491
Sapindaceae	*Acer*	*Acer platanoides*	49391	4.64972002
Sapindaceae	*Acer*	*Acer pseudoplatanus*	46290	4.35778866
Sapindaceae	*Acer*	*Acer rubrum*	1197	0.11268682
Sapindaceae	*Acer*	*Acer rufinerve*	26	0.00244767
Sapindaceae	*Acer*	*Acer saccharinum*	5970	0.562022
Sapindaceae	*Acer*	*Acer saccharum*	471	0.04434043
Sapindaceae	*Acer*	*Acer tataricum*	7	0.00065899
Sapindaceae	*Aesculus*	*Aesculus*	501	0.04716466
Sapindaceae	*Aesculus*	*Aesculus carnea*	1900	0.17886797
Sapindaceae	*Aesculus*	*Aesculus flava*	113	0.01063794
Sapindaceae	*Aesculus*	*Aesculus hippocastanum*	21864	2.05829966
Sapindaceae	*Aesculus*	*Aesculus indica*	928	0.08736288
Sapindaceae	*Aesculus*	*Aesculus parviflora*	9	0.00084727
Sapindaceae	*Aesculus*	*Aesculus pavia*	39	0.0036715
Sapindaceae	*Aesculus*	*Aesculus turbinata*	4	0.00037656
Sapindaceae	*Koelreuteria*	*Koelreuteria*	2	0.00018828
Sapindaceae	*Koelreuteria*	*Koelreuteria paniculata*	1544	0.14535376
Simaroubaceae	*Ailanthus*	*Ailanthus altissima*	3599	0.3388136
Tamaricaceae	*Tamarix*	*Tamarix*	37	0.00348322
Tamaricaceae	*Tamarix*	*Tamarix africana*	26	0.00244767
Tamaricaceae	*Tamarix*	*Tamarix gallica*	27	0.00254181
Tamaricaceae	*Tamarix*	*Tamarix parviflora*	14	0.00131797
Tamaricaceae	*Tamarix*	*Tamarix tetrandra*	83	0.00781371
Taxaceae	*Taxus*	*Taxus*	134	0.0126149
Taxaceae	*Taxus*	*Taxus baccata*	7832	0.73731261
Theaceae	*Camellia*	*Camellia*	8	0.00075313

Tracheophyta	*Cercidiphyllum*	*Cercidiphyllum japonicum*	250	0.02353526
Tracheophyta	*Parrotia*	*Parrotia persica*	1487	0.13998772
Ulmaceae	*Ulmus*	*Ulmus*	4044	0.38070636
Ulmaceae	*Ulmus*	*Ulmus glabra*	764	0.07192375
Ulmaceae	*Ulmus*	*Ulmus laevis*	28	0.00263595
Ulmaceae	*Ulmus*	*Ulmus minor*	302	0.02843059
Ulmaceae	*Ulmus*	*Ulmus procera*	5789	0.54498247
Ulmaceae	*Ulmus*	*Ulmus x hollandica*	104	0.00979067
Ulmaceae	*Zelkova*	*Zelkova*	11	0.00103555
Ulmaceae	*Zelkova*	*Zelkova carpinifolia*	196	0.01845164
Ulmaceae	*Zelkova*	*Zelkova serrata*	800	0.07531283

Table A2: Focus species with cluster scores for the trait, SDM and overall scores, with confidence statement. Estimated cluster scores indicated by purple shading in cells.

Species/Genera	LDMC	WD	TLP	SDM (Inner)	SDM (Greater)	Inner London Score	Greater London Score	Outcome (Inner)	Outcome (Greater)	Confidence
Acer								Moderate resilience	Moderate resilience	Low
Acer campestre	2	2	3	1	4	2	2.75	Moderate resilience	Moderate resilience	High
Acer platanoides	3	2	3	1	4	2.25	3	Moderate resilience	High resilience	High
Acer pseudoplatanus	3	2	2	4	4	2.75	2.75	Moderate resilience	Moderate resilience	High
Aesculus hippocastanum	3	2	1	1	4	1.75	2.5	Low resilience	Moderate resilience	High
Alnus glutinosa	3	2	2	1	4	2	2.75	Moderate resilience	Moderate resilience	High
Betula								Moderate resilience	Moderate resilience	Low
Betula pendula	3	2	2	1	1	2	2	Moderate resilience	Moderate resilience	High
Betula pubescens	2	2	2	4	4	2.5	2.5	Moderate resilience	Moderate resilience	High
Carpinus betulus	2	3	3	2	2	2.5	2.5	Moderate resilience	Moderate resilience	High
Corylus avellana	3	2	2	4	4	2.75	2.75	Moderate resilience	Moderate resilience	High
Crataegus laevigata	3	3	3	1	4	2.5	3.25	Moderate resilience	High resilience	Low
Crataegus monogyna	3	2	3	1	4	2.25	3	Moderate resilience	High resilience	High
Fagus sylvatica	4	3	3	1	4	2.75	3.5	Moderate resilience	High resilience	High
Fraxinus								High resilience	High resilience	Low
Fraxinus excelsior	4	2	3	4	4	3.25	3.25	High resilience	High resilience	High
Ilex aquifolium	3	3	2	4	4	3	3	High resilience	High resilience	High
Juniperus communis	4	3	3	4	4	3.5	3.5	High resilience	High resilience	Low
Malus								Moderate resilience	Moderate resilience	Low
Malus sylvestris	3	2	2	1	4	2	2.75	Moderate resilience	Moderate resilience	Low
Pinus sylvestris	4	2	2	1	4	2.25	3	Moderate resilience	High resilience	High
Platanus x hispanica	2	3	2	1	1	2	2	Moderate resilience	Moderate resilience	High
Populus nigra	2	1	1	1	1	1.25	1.25	Low resilience	Low resilience	High

Populus tremula	3	2	3	1	1	2.25	2.25	Moderate resilience	Moderate resilience	High
Prunus								Moderate resilience	Moderate resilience	Low
Prunus avium	2	2	2	1	4	1.75	2.5	Low resilience	Moderate resilience	High
Prunus cerasifera	3	3	2	1	4	2.25	3	Moderate resilience	High resilience	Low
Prunus padus	3	2	2	4	4	2.75	2.75	Moderate resilience	Moderate resilience	Low
Pyrus								Moderate resilience	Moderate resilience	Low
Quercus petraea	3	3	3	4	4	3.25	3.25	High resilience	High resilience	High
Quercus robur	3	2	3	1	4	2.25	3	Moderate resilience	High resilience	High
Robinia pseudoacacia	3	3	1	1	4	2	2.75	Moderate resilience	Moderate resilience	High
Salix caprea	3	2	2	4	4	2.75	2.75	Moderate resilience	Moderate resilience	High
Salix pentandra	2	2	1	1	4	1.5	2.25	Low resilience	Moderate resilience	Low
Sorbus								Moderate resilience	Moderate resilience	Low
Sorbus aria	2	4	2	4	4	3	3	High resilience	High resilience	Low
Sorbus aucuparia	3	3	3	4	4	3.25	3.25	High resilience	High resilience	High
Sorbus torminalis	4	3	3	1	4	2.75	3.5	Moderate resilience	High resilience	High
Taxus baccata	3	3	3	4	4	3.25	3.25	High resilience	High resilience	High
Tilia								Moderate resilience	Moderate resilience	Low
Tilia cordata	3	1	3	1	4	2	2.75	Moderate resilience	Moderate resilience	High
Tilia platyphyllos	3	2	3	1	4	2.25	3	Moderate resilience	High resilience	High
Tilia x europaea	3	3	3	1	1	2.5	2.5	Moderate resilience	Moderate resilience	High

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250623_1712_1 UPL Interim Report June 2025 – London: Comments in pdf

Page	Comment
2	The Greater London Authority and the Forestry Commission
2	You are missing some wording here - maybe something like: 'commissioned Urban Plant Lab (UPL)
2	In this Introduction / context setting, it would be useful for the role of partners to be highlighted more explicitely (LTOA & GiGL) e.g. the LTOA Climate Adaptation & Tree Planting working parties taking part in the steering group feeding back on the draft report,, LTOA members supplying tree inventory data, and GiGL compiling the data.
2	This context setting section could also briefly refer to the Treeconomics works & findings as well as Kew's Landscape Legacy Plan. The work Treeconmics conducted highlighted high potential future vulnerability that generated the appetite to go further. The Kew work demonstrated how the methodology could be made more robust...
8	or this Phase II, it would be helpful to break it down more clearly (with subheadings) into the different component parts of the composite score - ie: 1/ Context: The climate changes London trees are facing, e.g. increased heat, constant annual precipitation, but more prolongued drought period (less even rainfall distribution) plus the impact of UHI 2/ Scoring plant traits 4-point scoring of resilience targeting plant traits reflecting drought tolerance. Outputs: WD, LDMC and TLP scores for each species 3/ Scoring species distribution 4-point scoring of resilience based on degree of occurrence in future climate analogues (with climate analogues accounting for both MAT and CMI - and match to both inner and outer London conditions) Output: SMD score for inner London and Outer London for each species 4/ Putting both scores together into a composite resilience score for each species studied, for inner and outer London, plus a confidence statement. ....I wonder also if you could have a simple diagram capturing your resilience scoring methodology (i.e. showing its component parts are added and averaged d to produce the composite scores)? e.g. (WD score + LDMC score + TLP score+ SDM score)/4 = composite score
8	The area with high UHI index spreads beyond the City of London boundaries. Could we refer to 'Inner London' instead?
8	DO you mean 'Outer'? Greater London refers to the whole of London, including the City
9	These graphs are hard to read. Do you think you could have values for Inner & Outer London on the same graph to allow easier comparisons? (e.g. maybe two dots, or two bars side by side for each time horizon considered
11	Table A2 presents the resilience score for each trait based on which cluster each specie fell in e.g. 1, 2, 3, and 4. The averaging into the composite score only comes into play once you have added the resilience score based on degree of occurrence in climate analogue, correct? You don't actually average the plant traits scoring on their own before integrating the SDM score to produce the final composite scoring, so I find it a bit confusing to have this explained here. I think you could keep this explanation for later, when you introduce the composite score.
13	Outer
13	Here you are jumping into the composite score, correct? (ie. as presented in table A2 in the Appendix) I think we are going to need more explanations on this last step - about how the resilience score based on plant traits reflecting drought tolerance, and the resilience score based on degree of occurrence in climate analogues are brought together into this final, composite appraisal of resilience. My understanding is the math works as follow: (LDMC score + WD score+ TLP score + SMD score)/4 = composite resilience score Take 'Acer Campestre' Inner London: (2+2+3+1)/4 = 2 Outer London: ((2+2+3+4)/4 = 2.75

	Then if this composite score < 2, then 'Low resilience' If composite score = or > 2 but <3, then 'Moderate resilience' If composite score > 3, then 'High resilience'

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: Next tuesday & timeframe for Resilience report release
Date: 25 September 2025 16:53:00

Dear both,

I have two queries.

1. Would one of you be comfortable giving a 5-minute update on the work you have been doing for us during the London Urban Forest Partnership network meeting next Tuesday? E.g. recap the objective, your approach (briefly – incl. the June stakeholder workshop), a couple headlines (without revealing the full set of scores) & timescale for release & dissemination (see below)… Please send me any slide you want to use by 3pm on Monday.
2. Publication timescales: we are currently aiming for 24 November. With this in mind, we need to work to the milestones shown below: please confirm that these work for you (I have just received confirmation from our GIS/UI dev team that they were able to develop a new version of the London Public Realm Tree Map, showing climate suitability scores, to that timeframe)
   - First draft of the final report sent by [redacted] to [redacted] & [redacted] circulate to review group **by COB** on **13 October**.
   - [redacted] to test Adobe Acrobat Accessibility Check on the draft version of the report, with a view to resolve any accessibility issues no later than **31 October** ('Pass' report sent to [redacted] on that date).
   - [redacted] to collate review group comments received and send back to [redacted] by COB on **31 October**
   - Final report incorporating comments + Adobe Acrobat Accessibility Check on final version of the report (showing a full 'Pass') sent to [redacted] **by noon** on **10 November** – alongside your final invoice.
   - Report published on 24 November (National Tree Week) on the London Urban Forest Resource Hub
   - Event scheduled for 24 February at Kew (with option for remote access for part of the event) with London Urban Forest Partnership Network and wider relevant national contacts to promote findings, explore implications, incl. follow-on projects / early adopters.

Thank you!

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: PLEASE SEND COMMENTS BY 27 OCT: "Future Climate Suitability of London's Public Realm Trees" final draft report
Date: 13 October 2025 12:16:34
Attachments: UPL DRAFT Final Report October 2025.docx

Dear all,

As agreed during our June workshop, please find attached for your review Urban Plan Lab (UPL)'s *Future Climate Suitability of London's Public Realm Trees* final draft report.

Please send your comments to me no later than COB Monday 27 October 2025.

At this stage, **the report and its findings remain confidential**: **please do not share onwards** without checking with me first.

As you will see, [redacted] and [redacted] have further refined their data analysis to break into two the large 'moderate suitability' category into which most species previously fell into. They have also expanded the scope of their work, to now cover 95% of the total number public realm trees in London. This version of the report also includes the analysis of London's 'long tail' of tree species (e.g. species already present in London and therefore already commercially available, but not common) offering potential for greater use to help support tree diversifications efforts while tree production progressively evolves to better meet the London tree market needs. Finally, [redacted] and [redacted] have also included their recommendations on next steps/key priorities for action.

I am immensely grateful for the immense time(!), determination, and mix of creative and critical thinking [redacted] and [redacted] have brought to this project. Now it's time for our input, to help make this work as impactful as it can be.

I would particularly welcome your feedback on:

1. CLARITY: Are all aspects of the report clear to you or are there aspects that you feel require further clarifying? Please bear in mind that we are aiming the body of the report to a professional/tree practitioner audience. The executive summary (not included in the version attached) will be worded in plain language.
2. AN EFFECTIVE SPRINGBOARD: Are you confident the recommendations place adequate emphasis on the priorities that require action and do so in a way that provide relevant stakeholders with a solid platform they can use. We want effective enabling, without cornering.
3. VISUAL IMPACT/COVER: What would make an impactful cover? Any image you may be able to suggest welcome.

I will collate, synthesize, and share your comments with the UPL team who will make final edits prior to handing the document over to a graphic designer. If you comment about presentation, please bear in mind that what you see now is not what the final report will look like.

We are aiming to publicly launch the report at the end of November. An updated version of the London Public Realm Tree Map will be launched alongside of UPL's report, helping (among other things) to visualise the findings spatially. The London public realm tree dataset, which will show UPL's climate suitability scores, will also be available for download.

In due course, I will share with you and all members of the London Urban Forest Partnership some suggestions on how we can all support and make the most of the public

release of this outstanding work. **Please do not hesitate to reach out to me if you have some thoughts on Coms around this project**.

Many thanks for your time and thoughtful contributions to this work.

Kind regards,

[redacted]

Senior Policy and Programme Officer
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My pronouns are: [redacted]

OCTOBER 10, 2025

Commented [AH1]: Cover image suggestions welcome.

FUTURE CLIMATE SUITABILITY OF LONDON'S PUBLIC REALM TREES

FINAL REPORT

ANDREW HIRONS AND KEVIN MARTIN
URBAN PLANT LAB

URBAN PLANT LAB

Add page for front matter: authors, acknowledgements, funders, contents…

[redacted] [redacted] and team – What about a Forward? If so, who should write it?

Document to be subject to graphic design, however, here it is left in Word format for ease of collecting feedback from key stakeholders.

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Executive Summary
To be completed after review process.

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Introduction

London's urban forest contributes to the wellbeing of residents and visitors in manifold ways. Whilst as a whole, London's urban forest is taxonomically rich, relatively few species dominate. To support an agenda of strategic diversification, it is critical to evaluate the vulnerability of London's current tree stock to a changing climate. Therefore, the Greater London Authority, on behalf of London's Urban Forest Partnership, commissioned an analysis of the likely suitability of London's trees to a future climate scenario. This directly supports goal 1 of the London Urban Forest Plan which states: *Enhance the resilience of London's urban forest to the threats posed by climate change, pests and diseases.*

Goal 1: Enhance the resilience of London's urban forest to the threats posed by climate change, pests and diseases

Figure 1: Goal 1 from the London Urban Forest Plan 2025 Actions Update[1] directly relates to the objectives of this project.

Using collated tree inventory data from local authorities within the Greater London Authority area, species comprising of 95% of London's public realm trees have been evaluated for their likely suitability to London's climate in 2090 under a SSP3[2] scenario.

The project objectives were to:

I. Determine the suitability of London's most important urban tree species to a future climate scenario.
II. Recommend strategic tree management objectives to mitigate climate-related risks to London's urban forest.

[1] London Urban Forest Plan – 2025 Actions Update
[2] Shared Socioeconomic Pathway 3 (Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I. and Huang, M., 2021. Climate change 2021: the physical science basis. *Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change*, *2*(1), p.2391. https://doi.org/10.1017/9781009157896)

Review of the taxonomic composition London's public realm trees.

The Greenspace Information for Greater London CIC provided a data cache compiling tree inventory data for most of London's boroughs and provided a dataset with 1,187,924 observations. These data were cleaned to remove 19,574 observations that either recorded too high a taxonomic level or were not trees (details of removed observations can be found in Appendix 1 - Supplementary Data). Accordingly, the final dataset had 1,168,350 tree observations that were subject to analysis.

Commented [AH2]: Question for [redacted] Would you like us to be specific about which boroughs submitted data?

Public realm trees within London are taxonomically diverse and include 44 families, 110 genera and 375 species (Figure 2). Proportionally, the most important family is the *Rosaceae* (rose family); it accounts for 29% of public realm trees and contains important genera such as, cherries (*Prunus* (14%)), rowans (*Sorbus* (4%)) and hawthorns (*Crataegus* (4%)) (Figure 2). Other important genera are the maples (*Acer* (14%)), limes (*Tilia* (9%)), oaks (*Quercus* (7%)), planes (*Platanus* (7%)), ash (*Fraxinus* (6%)) and birch (*Betula* (5%)) (Figure 2). Interestingly, the cypress family (*Cupressaceae*) is represented by 15 different genera, yet only makes up around 2% of the urban forest.

At a species level, the most frequently observed species was '*Prunus*'. Of course, this is a genus rather than a species, so accurate taxonomic interpretation is challenging. However, when *Prunus* is recorded, surveyors are most likely referring to some type of flowering cherry. A similar lack of species resolution is apparent within numerous important genera. As it is impossible to determine the species composition of a pooled group, these genus-level 'species' have been preserved in the analysis: this will be a minor source of error. However, it is very unlikely that a major tree species has not been recorded, rather the relative proportions of some species may be slightly misrepresented. These errors could be removed through future surveying efforts and should motivate the introduction of a standardised data collection protocol across London.

London plane (*Platanus x hispanica* (7%)), pedunculate oak (*Quercus robur* (6%)), Norway maple (*Acer platanoides* (5%)), European ash (*Fraxinus excelsior* (5%)) and sycamore (*Acer pseudoplatanus* (5%)) are the most important species within London's public realm trees (Figure 3, 4, 5). A detailed breakdown of the taxonomic analysis is found in table A1 in Appendix 1.

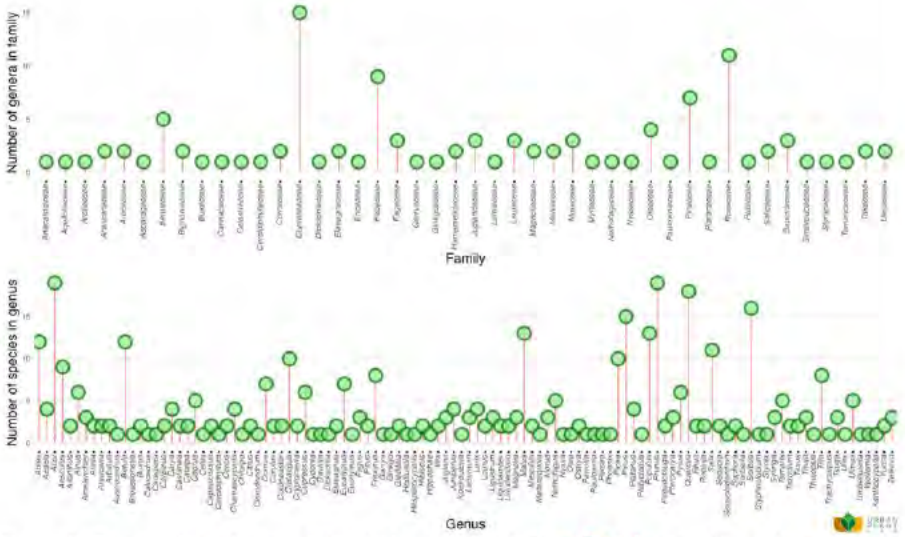

Figure 2: Taxonomic make up of London's public realm trees. Upper panel: number of genera represented by the 44 botanical families. Lower panel: number of species in each of the 110 genera.

Figure 3: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles; colour represents the botanical family. Labels are included for the 10 most represented family, labels for the less significant families are omitted for clarity.

Figure 4: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles; colour represents the genus. Labels are included for the 10 most represented genera, labels for the less significant genera are omitted for clarity.

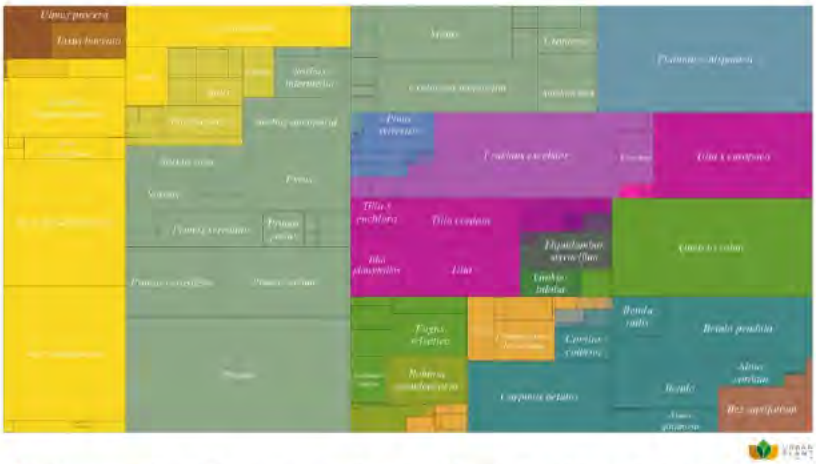

Figure 5: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles the population of the species; colour represents the botanical family. Labels are included for the 50 most represented species, labels for the less significant species are omitted for clarity.

Evaluating climate suitability for London's public realm trees.

It is clear that even under the current climate, London is already subject to a substantive urban heat island effect (Figure 6). This makes the growing environment for many tree species challenging, especially when combined with sub-optimal rooting environments. Under future climate scenarios the climate pressure with respect to tree growing conditions is set to intensify (Figure 7).

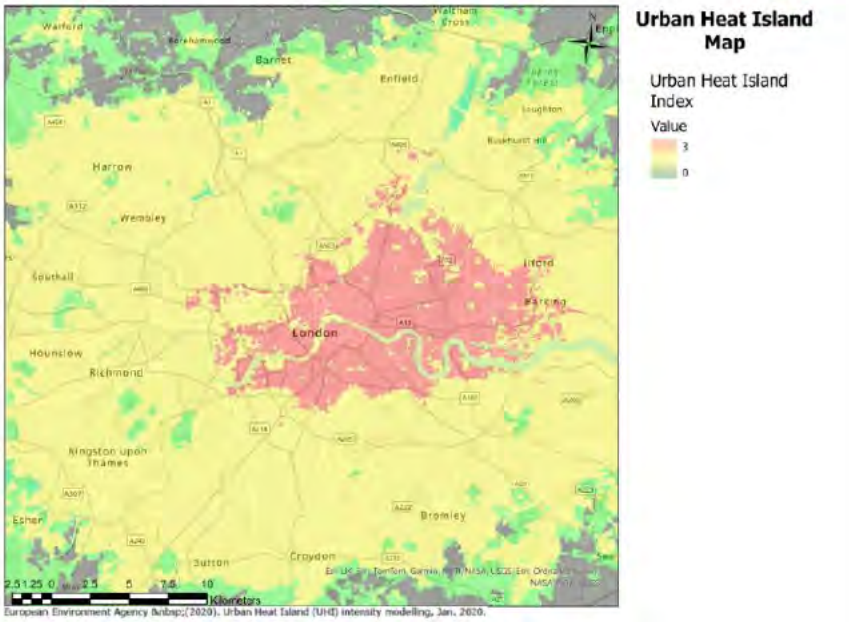

Figure 6: Urban heat island of London in degrees Celcius.

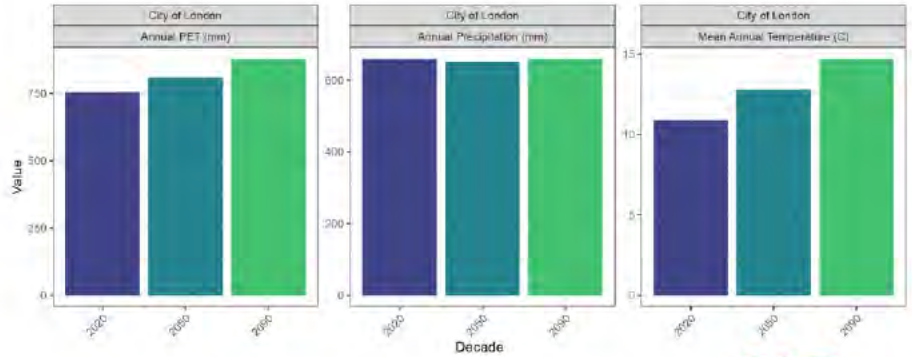

Figure 7: Key climate metrics for the City of London in response to climate scenario SSP3.

From the perspective of establishing, growing and maintaining trees, the climate in London is set to become more challenging for many species. This is mainly as a function of increasing mean annual temperature as precipitation is set to remain relatively stable. Annual potential evapotranspiration rates will increase with temperature, so water deficits are likely to become more acute even in the circumstance where precipitation levels are maintained.

Our methodological approach to species evaluation

Understanding the climate suitability of a species is challenging as it is likely to depend not only on the species but also on the ecotypic provenance of the tree in question. Thus, there may be both intraspecific and interspecific variation in climate suitability across the trees used in London's public realm. Furthermore, the quality of the data used to inform the future suitability will have a material influence on the outcome statements associated with the species. For many species, high quality data is available, but for some species, limited data reduces the confidence of analysis.

Urban Plant Lab utilises climate modelling tools and plant traits to infer tree species suitability to future climate scenarios. No single metric gives an infallible estimation of suitability, therefore, we developed a novel composite score for climate suitability based on species distribution modelling (SDM) and three key plant traits that are instructive in relation to ecological strategy and stress tolerance[3]. Whilst there is a multiplicity of techniques that could be used to evaluate likely stress tolerance, extensive controlled-environment trials combined with common-garden experiments are not viable for hundreds of species. It is, therefore, critical when screening large inventories to utilise tools and datasets that already exist.

Climate and Species Distribution Modelling

We integrated future climate modelling with plant functional trait data to assess the suitability of tree species found within London. Downscaled CHELSA projections[4] of the Climatic Moisture Index (CMI) for London in the 2090s provided estimates of future temperature and moisture balance (based on ratio of annual potential evapotranspiration and precipitation; see figure 7. Species-specific tolerance limits (5th to 95th percentile CMI values) from cleaned GBIF observation data[5] were compared with these projections to determine whether London's future climate falls within, at the edge of, or outside a species' specific climatic niche. To capture biological stress tolerance, we incorporated three key functional traits leaf dry matter content (LDMC), wood density (WD), and leaf turgor loss point (TLP) grouped into clusters representing different tendencies from highly acquisitive species characterised by fast growth and low stress tolerance to more conservative species characterised by high stress tolerance. For each species, climate suitability and trait clusters were combined into a composite score that classifies species as: 'High suitability', 'Moderate suitability', 'Low suitability' or 'Vulnerable' under late-century conditions.

The species distribution modelling is based on analysis of global plant and climate data, this facilitates the plotting of species distributions in the context of climate. When assessing how well a tree species might cope with future climate conditions, it is important to consider more than just temperature. Whilst mean temperature of the growing season (MTGS[6]) gives a good indication of thermal preferences, it does not reflect how much water is available to the plant — a key factor in its landscape performance.

[3] Sjöman, H., Hirons, A. and Martin, K.W., 2025. Species-specific evaluation of growth and environmental tolerance for ecosystem services–evaluation from a botanic tree collection. *Urban Ecosystems*, *28*(3), p.114.
[4] https://chelsa-climate.org/
[5] https://www.gbif.org/
[6] Growing season is defined as April to October (inclusive).

To provide a more comprehensive analysis, we included the Climatic Moisture Index (CMI), which reflects the balance between precipitation and evaporation. CMI helps us understand how dry a place is likely to be, both now and in the future. By using both MAT and CMI together, we gain a clearer understanding of the climate envelope in which a species can thrive. This is especially important as climate change is expected to bring not just warmer temperatures but also changes in water availability. An example of a species distribution model can be seen for a suitable species, holm oak (*Quercus ilex*) and a vulnerable species, silver birch (*Betula pendula*) (Figure 8).

To evaluate the climatic suitability of each species, the model compares the local Climatic Moisture Index (CMI) of each city with the species-specific tolerance thresholds (Q05 and Q95) from the TreeGOER database[7]. Cities are classified into CMI Zones, Optimal, Within Range, or Outside Range, based on whether local conditions exceed, fall within, or are below the species' tolerance limits. Each city is then assigned a climate suitability score on a four-point scale, where conditions above the optimal threshold receive the highest score, intermediate values receive moderate scores, and conditions below the lower tolerance receive the lowest score. This approach allows a clear, quantitative assessment of how well London's climate aligns with the ecological preferences of different species.

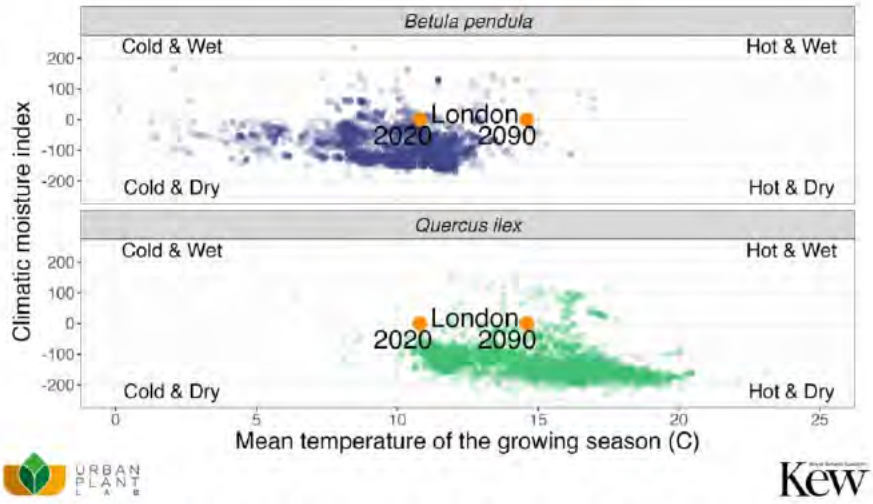

Figure 8: Example of a species distribution model for silver birch (*Betula pendula*), a 'Vulnerable' species and holm oak (*Quercus ilex*), a 'High suitability' species. Each point represents a population of the species in relation to its climate. The larger orange points represent the current and future climate of London according to SSP3. N.B.: A climate moisture index of 0 represents a climate in which the potential evapotranspiration is equal to precipitation.

[7] Kindt, R. (2023) TreeGOER: A database with globally observed environmental ranges for 48,129 tree species. Global Change Biology, 29(22), pp.6303-6318.

Plant trait analysis

Plant traits are measurable characteristics that are known to assist in the inference of species' (or genotype) ecological strategy in relation to growth, reproductive capacity or stress tolerance. Global plant trait data (TRY Database)[8] were combined with data collected from our research group and other published literature. The chosen traits were then clustered into four groups using k-means[9] to provide an individual trait score of one to four. In this way, we allocate the trait score using statistical methodology that is informed by global datasets rather than making subjective decisions on the threshold values between scores. For example, global wood density was evaluated and clustered to give figure 9, these cluster scores were then extracted for the species evaluated. The three traits included in this analysis were:

Wood Density (WD)

Wood density (g cm^3) integrates a number of aspects of ecological strategy. Species with higher density wood are found in more stressful sites that require greater investment in stress resilience and defence, whereas those with less dense wood are more competitive on fertile sites, but less resilient to stress[10]. Temperature has been found to be a major, global driver for wood density variation[11], thus it is instructive when evaluating tree stress resilience to future climate scenarios.

[8] Kattge, J., Bönisch, G., Díaz, S., Lavorel, S., Prentice, I.C., Leadley, P., Tautenhahn, S., Werner, G.D., Aakala, T., Abedi, M. and Acosta, A.T. (2020) TRY plant trait database–enhanced coverage and open access. *Global change biology*, *26*(1), pp.119-188.

[9] Hartigan, J.A. and Wong, M.A., 1979. Algorithm AS 136: A k-means clustering algorithm. *Journal of the royal statistical society. series c (applied statistics)*, *28*(1), pp.100-108.

[10] Chave, J., Coomes, D., Jansen, S., Lewis, S.L., Swenson, N.G. and Zanne, A.E. (2009) Towards a worldwide wood economics spectrum. *Ecology letters*, *12*(4), pp.351-366.

[11] Mo, L., Crowther, T.W., Maynard, D.S., Van den Hoogen, J., Ma, H., Bialic-Murphy, L., Liang, J., De-Miguel, S., Nabuurs, G.J., Reich, P.B. and Phillips, O.L., 2024. The global distribution and drivers of wood density and their impact on forest carbon stocks. *Nature Ecology & Evolution*, pp.1-18.

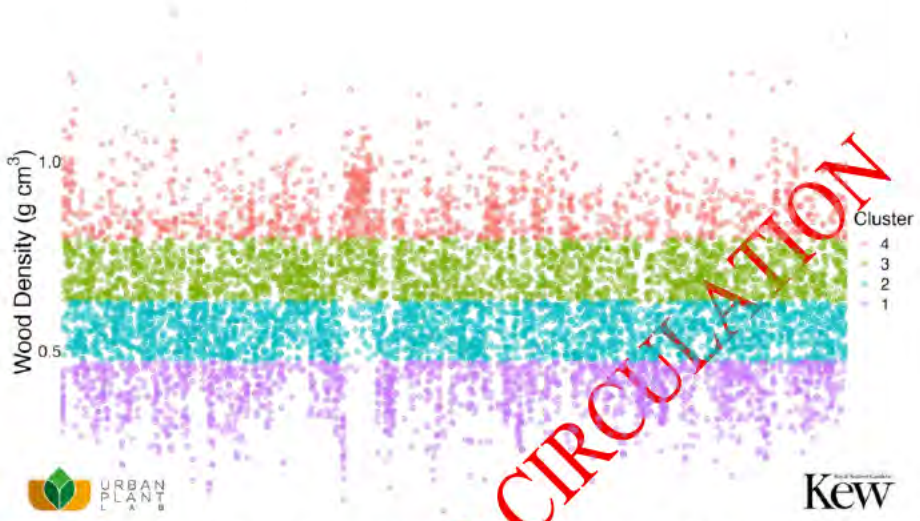

Figure 9: Example of the way in which cluster analysis was used to derive a four-point score and used to contribute to the overall climate suitability score. In the case of the wood density trait: 4 was awarded for a density above 0.78 (g/cm³); 3 was awarded for between 0.61 – 0.78; 2 was awarded between 0.46 and 0.61; and, a score of 1 for <0.46. Cluster levels were determined using the k-means method. A similar analysis was used for the other plant trait data (LDMC, TLP: (plots not shown)).

Leaf Dry Matter Content (LDMC)
Research has shown[12] that LDMC (mg g^{-1}) is related to stress resilience: species with a low LDMC are more vulnerable to heat and drought than those with a high LDMC. Higher LDMC reflects a greater investment in leaf tissue robustness that is necessary to cope with periods of water deficit and represents a more conservative ecological strategy.

Turgor Loss Point (TLP)
The leaf water potential at turgor loss (-MPa) directly quantifies leaf and plant drought tolerance. The more negative the TLP, the longer key physiological functions, such as hydraulic conductance and stomatal conductance can be maintained under soil drying[13]. It is widely used in ecological studies and in research used to inform tree selection for urban environments[14].

Determination of Outcome Statements

[12] Petruzzellis, F., Tordoni, E., Di Bonaventura, A., Tomasella, M., Natale, S., Panepinto, F., Bacaro, G. and Nardini, A. (2021) Turgor loss point and vulnerability to xylem embolism predict species-specific risk of drought-induced decline of urban trees. *Plant Biology*, *24*(7), pp.1198-1207.
[13] Bartlett, M.K., Scoffoni, C. and Sack, L. (2012) The determinants of leaf turgor loss point and prediction of drought tolerance of species and biomes: a global meta-analysis. *Ecology letters*, *15*(5), pp.393-405.
[14] Hirons, A.D., Watkins, J.H.R., Baxter, T.J., Miesbauer, J.W., Male-Muñoz, A., Martin, K.W., Bassuk, N.L. and Sjöman, H. (2021) Using botanic gardens and arboreta to help identify urban trees for the future. *Plants, People, Planet*, *3*(2), pp.182-193.

The species' scores for the SDM, WD, LDMC and TLP was averaged (mean) to give a composite score: the lowest possible score is one and the highest possible score is four. Species scoring between one to two were evaluated as being 'Vulnerable'. Those species that scored between two and three that were noted to have their current species distribution 'outside of range' for the future climate projection were evaluated as having 'Low suitability' whilst those that were found to be 'within range' were evaluated as having 'Moderate suitability'. Only those species with a composite score of between three and four were evaluated as having 'High suitability'. The high suitability species will also have had evidence that their current distribution is within range of London's future climate and had trait evidence suggesting high stress tolerance (Table 1).

Whilst the quality of the data was high for many species, it is important to acknowledge that a data deficit was apparent in some cases. For example, there may not be data for all the desired traits available. In such cases, a trait cluster score was assigned using data from closely related species for which data was available and expert judgement. To enhance transparency of the analysis a confidence score has been allocated to each outcome statement (Table 2). Low confidence was allocated to species that have had scores estimated for two or more of the criteria being evaluated, whilst high confidence was allocated to species that have a maximum of one estimated trait cluster. In addition to improving the transparency of the analysis, this also provides a gap-analysis to help focus future research efforts.

Table 1: Explanation of outcome statements.

Outcome statements	Narrative description of outcome
High suitability	This species is suited to the current climate norms and its current distribution substantially overlaps with the future climate analogue. Traits indicate excellent tolerance to climate-related stress. These species are likely to have high suitability to future climate. Provenance and ecotype selection is likely to optimise future climate compatibility.
Moderate suitability	This species is suited to the current climate norms and its current distribution overlaps with the future climate analogue at its margin. Traits indicate good tolerance to climate-related stress. Therefore, these species are likely to have moderate suitability to future climate. With focused effort, targeted ecotype and provenance selection is likely to yield plant material that will have high suitability for future climate scenarios.
Low suitability	These species are suited to the today's climate but only a very minor percentage of the species' current distribution occurs in regions within a future climate analogue. Traits indicate some vulnerability to climate-related stress. Therefore, these species are likely to have a low suitability to future climate. With focused effort, targeted ecotypic and provenance selection may yield suitable plant material for successful cultivars. Examples of these species currently in the landscape may require more intensive management to mitigate abiotic stress and maintain tree performance.
Vulnerable	These species are suited to today's climate but their current distribution does not occur in regions within a future climate analogue. Traits indicate vulnerability to climate-related stress. Therefore, these species are likely to have vulnerability to future climate scenarios; targeted ecotype and provenance selection is not likely to yield suitable plant material for successful cultivars. Examples of these species currently in the landscape may require more intensive management to mitigate abiotic stress and maintain tree performance.

Climate suitability of London's Public Realm Trees - Results

To deliver a comprehensive evaluation of London's public realm trees, we selected the top 100 species from the taxonomic review and evaluated them for their suitability to a future climate scenario (SSP3). In concert, these species comprised of 95% of London's public realm trees. Therefore, this analysis represents a comprehensive evaluation of the London's public realm trees. Only very minor species representing less than 0.12 % have not been subject to analysis.

London is assessed to only have two species, holm oak (*Quercus ilex*) and Persian ironwood (*Parrotia* persica) or 0.38% or the public realm trees that is considered to have 'high suitability' (figure 11). This is a species native to the Mediterranean basin and western Asia. A further 22.05% of the public realm trees have been assessed to have 'moderate suitability'. The most important trees of 'moderate suitability' are London plane (*Plantanus* x *hispanica*) and hawthorn (*Crataegus monogyna*). 'Low suitability' trees make up 62.35% of London's public realm trees, this category includes pedunculate oak (*Quercus robur*), Norway maple (*Acer platanoides*) and sycamore (*Acer pseudoplatanus*). Unfortunately, 10.64% of the public realm trees were found to be 'vulnerable' to the projected conditions at the end of this century. This category includes ash (*Fraxinus excelsior*), *wild cherry* (*Prunus avium*) silver birch (*Betula pendula*) and large-leaved lime (*Tilia platyphyllos*). Further details of the species found with each category can be found in table 2.

It is striking that such a high percentage (73%) of trees are found within the lower two suitability categories. Climate risk to trees is further compounded by poor growing environments. Therefore, this presents a substantial and strategic challenge for urban forest managers to mitigate over the coming decades.

Percentage Suitability	Outcome statement
0.38%	High suitability
22.05%	Moderate suitability
62.35%	Low suitability
10.64%	Vulnerable
4.62%	Not evaluated

Figure 10: Summary of the percentage of trees in each suitability class. [Alternative infographic could be developed, but I think it is useful to have headlines presented in a clear format]

Tables 2 and 3 provide a more detailed breakdown of the species evaluation, together with a confidence score in the outcome statement.

Table 2 (option 1): Outcome summaries, with confidence statements for the 100 focus species of this study. Species were given a low confidence score when the cluster score for a trait had to be estimated, rather than based on data from the scientific literature.

Outcome Statement	Confidence Score	Species (TaxonName)
High suitability	High	*Quercus ilex*
	Low	*Parrotia persica*
Moderate suitability	High	*Acer negundo, Betula utilis, Crataegus monogyna, Juglans regia, Platanus x hispanica, Prunus cerasifera, Robinia pseudoacacia, Taxus baccata*
	Low	*Acer cappadocicum, Ailanthus altissima, Betula albosinensis, Betula jacquemontii, Betula papyrifera, Catalpa bignonioides, Celtis australis Chamaecyparis lawsoniana, Corylus colurna Crataegus x lavallei, Crataegus x persimilis, Cupressus, Fraxinus angustifolia, Fraxinus ornus Ginkgo biloba, Gleditsia triacanthos, Koelreuteria paniculata, Ligustrum, Ligustrum lucidum, Pinus nigra, Pyrus calleryana, Pyrus communis, Ulmus, X Cuprocyparis leylandii*
Low suitability	High	*Acer campestre, Acer platanoides, Acer pseudoplatanus, Acer saccharinum, Aesculus hippocastanum, Alnus glutinosa, Betula pendula, Carpinus betulus, Castanea sativa, Fagus sylvatica, Ilex aquifolium, Pinus sylvestris, Populus tremula, Quercus cerris, Quercus robur, Quercus rubra, Salix alba, Salix caprea, Sorbus aucuparia, Tilia cordata,*
	Low	*Alnus cordata, Amelanchier lamarckii, Crataegus laevigata, Liquidambar styraciflua, Malus pumila, Malus sylvestris, Malus x purpurea, Metasequoia glyptostroboides, Prunus domestica, Prunus laurocerasus, Prunus padus, Prunus serrulata, Prunus spinosa, Prunus x fruticans, Salix x fragilis, Sorbus, Sorbus aria, Sorbus intermedia, Sorbus x thuringiaca, Thuja plicata, Tilia x euchlora, Tilia x europaea, Ulmus procera*
Vulnerable	High	*Alnus incana, Betula pubescens, Fraxinus excelsior, Populus nigra, Prunus avium, Tilia platyphyllos*
	Low	*Aesculus x carnea, Liriodendron tulipifera, Magnolia, Populus alba, Salix babylonica,*

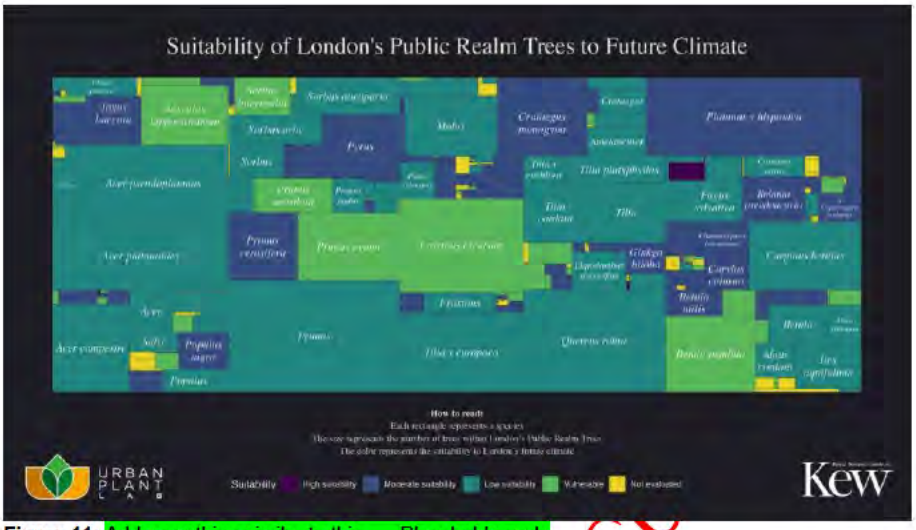

Figure 11: Add something similar to this… - Placeholder only

Table 3: Outcome summaries, with confidence statements for the 100 focus species of this study. Species were given a low confidence score when two or more cluster scores for a trait had to be estimated, rather than based on data from the scientific literature. Ranked from highest to lowest count.

Family	Genus | Species	Outcome statement	Confidence	Count	Percentage
Rosaceae	*Prunus*	Low suitability	Low	87837	7.52
Platanaceae	*Platanus x hispanica*	Moderate suitability	High	77569	6.64
Fagaceae	*Quercus robur*	Low suitability	High	66892	5.73
Sapindaceae	*Acer platanoides*	Low suitability	High	55775	4.77
Oleaceae	*Fraxinus excelsior*	Vulnerable	High	53362	4.57
Sapindaceae	*Acer pseudoplatanus*	Low suitability	High	52510	4.49
Malvaceae	*Tilia x europaea*	Low suitability	Low	45204	3.87
Betulaceae	*Carpinus betulus*	Low suitability	High	35029	3
Rosaceae	*Prunus avium*	Vulnerable	High	31803	2.72
Betulaceae	*Betula pendula*	Low suitability	High	31530	2.7
Sapindaceae	*Acer campestre*	Low suitability	High	31019	2.65
Rosaceae	*Crataegus monogyna*	Moderate suitability	High	27542	2.36
Rosaceae	*Malus*	Low suitability	Low	25652	2.2
Sapindaceae	*Aesculus hippocastanum*	Low suitability	High	23652	2.02
Rosaceae	*Pyrus*	Moderate suitability	Low	22769	1.95
Malvaceae	*Tilia*	Low suitability	Low	21562	1.85
Rosaceae	*Prunus cerasifera*	Moderate suitability	High	21472	1.84
Rosaceae	*Sorbus aucuparia*	Low suitability	High	17829	1.53
Malvaceae	*Tilia cordata*	Low suitability	High	17314	1.48
Aquifoliaceae	*Ilex aquifolium*	Low suitability	High	13706	1.17
Fabaceae	*Robinia pseudoacacia*	Moderate suitability	High	13208	1.13
Rosaceae	*Sorbus aria*	Low suitability	Low	12600	1.08
Rosaceae	*Prunus serrulata*	Low suitability	Low	12436	1.06
Malvaceae	*Tilia platyphyllos*	Vulnerable	High	11252	0.96

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Betulaceae	*Betula*	Low suitability	Low	10566	0.9
Fagaceae	*Fagus sylvatica*	Low suitability	High	10478	0.9
Rosaceae	*Sorbus intermedia*	Low suitability	Low	9788	0.84
Hamamelidaceae	*Liquidambar styraciflua*	Low suitability	Low	9562	0.82
Taxaceae	*Taxus baccata*	Moderate suitability	High	8982	0.77
Salicaceae	*Populus nigra*	Vulnerable	High	8481	0.73
Rosaceae	*Sorbus*	Low suitability	Low	8473	0.73
Sapindaceae	*Acer*	Low suitability	Low	8417	0.72
Cupressaceae	*Chamaecyparis lawsoniana*	Moderate suitability	Low	8314	0.71
Rosaceae	*Amelanchier*	Low suitability	Low	7855	0.67
Betulaceae	*Betula utilis*	Moderate suitability	High	6920	0.59
Oleaceae	*Fraxinus*	Low suitability	Low	6544	0.56
Sapindaceae	*Acer saccharinum*	Low suitability	High	6275	0.54
Betulaceae	*Alnus cordata*	Low suitability	Low	6183	0.53
Betulaceae	*Corylus colurna*	Moderate suitability	Low	6022	0.52
Ulmaceae	*Ulmus procera*	Low suitability	Low	5951	0.51
Betulaceae	*Alnus glutinosa*	Low suitability	High	5945	0.51
Pinaceae	*Pinus sylvestris*	Low suitability	High	5892	0.5
Cupressaceae	*X Cuprocyparis leylandii*	Moderate suitability	Low	5777	0.49
Fagaceae	*Castanea sativa*	Low suitability	High	5710	0.49
Ginkgoaceae	*Ginkgo biloba*	Moderate suitability	Low	5524	0.47
Salicaceae	*Populus*	Low suitability	Low	5396	0.46
Rosaceae	*Crataegus*	Low suitability	Low	5195	0.44
Malvaceae	*Tilia x euchlora*	Low suitability	Low	5036	0.43
Rosaceae	*Prunus padus*	Low suitability	Low	4936	0.42
Salicaceae	*Salix*	Low suitability	Low	4499	0.39
Ulmaceae	*Ulmus*	Moderate suitability	Low	4332	0.37

Magnoliaceae	*Magnolia*	Vulnerable	Low	4276	0.37
Fagaceae	*Quercus*	Low suitability	Low	4181	0.36
Fabaceae	*Gleditsia triacanthos*	Moderate suitability	Low	4073	0.35
Betulaceae	*Betula pubescens*	Vulnerable	High	3984	0.34
Cupressaceae	*Cupressus*	Moderate suitability	Low	3809	0.33
Simaroubaceae	*Ailanthus altissima*	Moderate suitability	Low	3795	0.32
Fagaceae	*Quercus cerris*	Low suitability	High	3725	0.32
Pinaceae	*Pinus nigra*	Moderate suitability	Low	3553	0.3
Rosaceae	*Amelanchier lamarckii*	Low suitability	Low	3286	0.28
Rosaceae	*Crataegus laevigata*	Low suitability	Low	3163	0.27
Salicaceae	*Salix caprea*	Low suitability	High	3030	0.26
Rosaceae	*Crataegus x persimilis*	Moderate suitability	Low	3007	0.26
Fagaceae	*Quercus ilex*	High suitability	High	2953	0.25
Rosaceae	*Pyrus communis*	Moderate suitability	Low	2790	0.24
Salicaceae	*Salix x fragilis*	Low suitability	Low	2773	0.24
Salicaceae	*Salix alba*	Low suitability	High	2768	0.24
Rosaceae	*Pyrus calleryana*	Moderate suitability	Low	2701	0.23
Salicaceae	*Populus alba*	Vulnerable	Low	2599	0.22
Fagaceae	*Quercus rubra*	Low suitability	High	2580	0.22
Betulaceae	*Betula jacquemontii*	Moderate suitability	Low	2550	0.22
Magnoliaceae	*Liriodendron tulipifera*	Vulnerable	Low	2529	0.22
Oleaceae	*Fraxinus ornus*	Moderate suitability	Low	2461	0.21
Sapindaceae	*Acer negundo*	Moderate suitability	High	2433	0.21
Rosaceae	*Malus sylvestris*	Low suitability	Low	2346	0.2
Betulaceae	*Alnus incana*	Vulnerable	High	2270	0.19
Sapindaceae	*Aesculus x carnea*	Vulnerable	Low	2194	0.19
Rosaceae	*Prunus x fruticans*	Low suitability	Low	2157	0.18

Oleaceae	*Ligustrum*	Moderate suitability	Low	2042	0.17
Rosaceae	*Malus pumila*	Low suitability	Low	1930	0.17
Rosaceae	*Prunus laurocerasus*	Low suitability	Low	1912	0.16
Rosaceae	*Crataegus x lavallei*	Moderate suitability	Low	1874	0.16
Oleaceae	*Fraxinus angustifolia*	Moderate suitability	Low	1859	0.16
Rosaceae	*Prunus spinosa*	Low suitability	Low	1856	0.16
Betulaceae	*Betula papyrifera*	Moderate suitability	Low	1760	0.15
Salicaceae	*Populus tremula*	Low suitability	High	1756	0.15
Rosaceae	*Malus x purpurea*	Low suitability	Low	1672	0.14
Bignoniaceae	*Catalpa bignonioides*	Moderate suitability	Low	1648	0.14
Sapindaceae	*Koelreuteria paniculata*	Moderate suitability	Low	1633	0.14
Rosaceae	*Prunus domestica*	Low suitability	Low	1622	0.14
Betulaceae	*Betula albosinensis*	Moderate suitability	Low	1595	0.14
Cupressaceae	*Thuja plicata*	Low suitability	Low	1546	0.13
Hamamelidaceae	*Parrotia persica*	High suitability	Low	1528	0.13
Salicaceae	*Salix babylonica*	Vulnerable	Low	1513	0.13
Rosaceae	*Sorbus x thuringiaca*	Low suitability	Low	1473	0.13
Cupressaceae	*Metasequoia glyptostroboides*	Low suitability	Low	1429	0.12
Juglandaceae	*Juglans regia*	Moderate suitability	High	1424	0.12
Sapindaceae	*Acer cappadocicum*	Moderate suitability	Low	1411	0.12
Cannabaceae	*Celtis australis*	Moderate suitability	Low	1411	0.12
Oleaceae	*Ligustrum lucidum*	Moderate suitability	Low	1359	0.12

Candidate species for future planting

Analysis of tree suitability to London's future climate suggests that from the pool of species already growing in London, ~100 species have high or moderate suitability (Table 4). These species, by nature of the fact that they are already found within London, are available through UK nurseries. Increasing the proportion of these species will enhance the suitability of the urban forest to conditions expected at the end of the century. As tree nurseries continue to tailor their species portfolio to reflect the demand for 'climate resistant' trees, the palette of trees found in table 4 is likely to expand further.

It should be noted that a diverse range of species is found within table 4. Choices around their relative merit for specific planting sites within the public realm should go through accepted tree selection decision-making protocols. This topic is discussed more fully in *Tree Selection for Green Infrastructure: A guide for specifiers*. Species profiles for the species represented in table 4 are found in Appendix 2.

Table 4: Species evaluated as high and moderate suitability which should play a role in the strategic diversification of London's urban forest. Native species in **bold**.

Outcome Statement	Species
High suitability	*Acer monspessulanum, Acer tataricum, Arbutus unedo, Cupressus arizonica, Cupressus macrocarpa, Eucommia ulmoides, Olea europaea, Ostrya carpinifolia, Parrotia persica, Quercus frainetto, Quercus ilex, Quercus suber,* ***Sorbus torminalis****, Tamarix ramosissima*
Moderate suitability	*Abies concolor, Acacia dealbata, Acer buergerianum, Acer cappadocicum, Acer davidii, Acer griseum, Acer negundo, Aesculus indica, Aesculus pavia, Amelanchier alnifolia, Betula albosinensis, Betula jacquemontii, Betula papyrifera, Betula utilis, Buxus sempervirens, Carya illinoinensis, Catalpa bignonioides, Catalpa speciosa, Cedrus atlantica, Cedrus deodara, Cedrus libani, Celtis australis, Celtis occidentalis, Cercis siliquastrum, Chamaecyparis lawsoniana, Corylus colurna, Corylus maxima, Crataegus x lavallei,* ***Crataegus monogyna****, Crataegus x persimilis, Cupressus sempervirens, Cydonia oblonga, Diospyros kaki, Elaeagnus angustifolia, Eucalyptus pauciflora, Fagus orientalis, Ficus carica, Ginkgo biloba, Gleditsia triacanthos, Gymnocladus dioica, Heptacodium miconioides, Hippophae salicifolia, Juglans nigra, Juglans regia, Juniperus scopulorum, Juniperus virginiana, Koelreuteria paniculata, Ligustrum japonicum, Ligustrum lucidum, Malus baccata, Malus yunnanensis, Morus alba, Morus nigra, Nothofagus antarctica, Paulownia tomentosa, Picea pungens, Pinus contorta, Pinus nigra, Pinus pinaster, Pinus pinea, Pinus radiata, Pinus wallichiana, Platanus x hispanica, Platanus orientalis, Pseudotsuga menziesii, Prunus cerasifera, Prunus dulcis, Prunus maackii, Prunus serrula, Pyrus calleryana, Pyrus communis, Quercus castaneifolia, Robinia pseudoacacia, Sequoia sempervirens, Sequoiadendron giganteum, Sorbus discolor, Sorbus*

Commented [AH3]: [redacted] would you like this in a different format? What do you think about the idea of including an appendix with the TDAG species profiles to aid interpretation.

	vilmorinii, Styphnolobium japonicum, Syringa vulgaris, Syringa reticulata, Tamarix gallica, Tamarix tetrandra, Taxodium distichum, ***Taxus baccata,*** *Tilia mongolica, Ulmus* (resistant cultivars), X *Cuprocyparis leylandii*

Possibly add New York figure as well? This is a very precise match for London's future late century climate so there is good evidence that these species will have good compatibility.

Recommendations

Public realm trees in London, along with the manifold benefits bestowed on communities, are threatened by a changing climate. This report makes clear that most (estimated at 72%) of the public realm trees will not be suitable for conditions expected at the end of this century. This suggests that these trees are likely to have reduced performance (growth and other ecosystem services) as a function of climate change: mortality rates within these species are also likely to increase. To mitigate the impact of this, we make the following recommendations:

1. *Proactively promote the health of existing trees*

Healthy trees are more resilient to stress. Tree performance will be enhanced when trees are growing in good-quality rooting environments characterised by sufficient soil volume and biologically healthy soils. Given an equivalence in climate, trees in healthy growing conditions experience stress more gradually and less acutely than trees growing in poor-quality conditions. There is long-term value in proactively enhancing tree growing environments, especially of large trees that contribute the greatest benefits to society. Enhancing rooting environments through soil decompaction and amelioration is a critical strategy to mitigate against climate-related stress in trees.

2. *Strategically diversify London's urban forest.*

Given the variation in species suitability, tree species diversity targets measured by taxonomic metrics may lead to increased taxonomic diversity without improving the resilience to future climate. Therefore, new tree planting should focus on species that are likely to be more suitable to London's future climate. Tree selection decisions must also be cognisant of biotic threats from emerging pests and pathogens. Future research should combine this climate suitability analysis with biotic plant health risks to produce a composite risk assessment of London's trees and provide guidance on planting palettes that are suitable for future climates and have low risk from biotic threats.

3. *Fund tree establishment, not tree planting*

Funding instruments designed to increase canopy cover should fund tree establishment, not tree planting. Whilst contracts and grants are awarded for tree planting, rather than the outcome of tree establishment, tree planting initiatives are likely to be compromised by low success rates. Current funding instruments need to be evaluated to ensure that species suitability is fully considered, tree planting aftercare is sufficiently funded and full payment to contractors only made after evidenced tree establishment (5 years after planting date). Funding spurious tree planting targets based on numbers of trees planted will not deliver vibrant, vital treescapes for future generations.

4. *Adopt a London tree data standard*

Tree demographic analysis will be made much more efficient and robust if a shared data standard is adopted. Indeed, accuracy in the outcomes of this report has been reduced by the quality of the underlying tree inventory data – despite it being the best available. Therefore, a Greater London Authority tree data standard should be adopted to support urban forest managers with accurate information. As a minimum: a nomenclature standard (for example, the taxonomic backbone of

Plants of the world online) and a standard way to measure tree dimensions should be agreed. It is also important to record tree mortality rates in a structured way to help evaluate any systemic failure as a function of species or management protocol.

5. Collaborate with tree nurseries

The provision of trees for our urban forest relies upon a supply chain from tree nurseries. To ensure that the correct species are available for purchase by London's urban forest managers, it is critical that there continues to be an active dialogue between the nursery sector and Local Authorities. As the lead-time for 'standard' size street trees is often between five to ten years – and could be longer – it is essential that nurseries have clear guidance from tree specifiers regarding the species palettes they require. To ensure availability of the most suitable species, Local Authorities should seek to contract grow these trees with nurseries, setting specific procurement targets for contract growing and collaborating across the Greater London Authority to achieve the economies of scale necessary to guarantee that suitable tree species are available within a biosecure supply chain.

6. Develop a strategic mechanism to get novel plant material into horticultural production.

The suitability of trees for London's future urban forest is a function of species and provenance. Unfortunately, knowledge of provenance (region of origin) is absent from most commercially produced trees. In many cases, particularly those identified as having 'Low' or 'Moderate' suitability in this report, targeted provenance selection is very likely to increase the compatibility with future climate scenarios. Research aimed at understanding intraspecific variation in plant traits and provenance selection using species distribution modelling aimed at selecting optimal plant reproductive material for London's future climate should be prioritised.

Whilst working within the constraints of the Nagoya Protocol (Compliance) Regulations 2015[15], mechanisms that facilitate the strategic introduction of new material into the horticultural trade via current botanic gardens and new, targeted collection expeditions.

7. Develop plant trait databases to inform tree selection

This analysis utilises global plant trait datasets to help inform tree tolerance to abiotic climate-related stress. However, many of the species did not have all relevant traits available, this resulted in a low confidence score for 65% of the outcome statements. Using this study as a gap analysis, research should prioritise the collection 'missing' trait (LDMC, WD, TLP) data in order to further improve the confidence of this analytical framework.

8. Evaluate potential impact of this analysis on canopy cover.

[15] Nagoya Protocol (Compliance) Regulations 2015

This report has delivered an analysis of tree suitability based on a taxonomic analysis. Variation in how tree dimensions are recorded, particularly the use of size classes (rather than actual tree dimensions) make statements relating to potential impact on canopy cover difficult. Once a new data standard has been adopted, evaluating tree suitability for future climate through the prism of canopy cover will help prioritise species selection for future climate scenarios. Remote sensing surveys using technologies such as LiDAR could greatly aid this task, providing tree dimensions can be accurately paired to species.

9. Develop London-wide strategies and structures to manage the whole of London's urban forest

Landscapes are not defined by political boundaries, therefore, wherever practicable, London-wide strategies for urban forest management should be adopted. Organisations such as the London Urban Forest Partnership should be enabled to help achieve this.

10. Apply this analytical framework to other cities and regions.

Leadership shown by the Greater London Authority and London's Urban Forest Partnership has enabled the development of a novel approach to tree suitability assessment. Other cities and regions could benefit from this approach to help inform their own contexts and ultimately help move towards a national understanding of tree suitability to future climate scenarios.

Limitations

Despite its strengths, this study acknowledges several limitations. Data gaps, including sparse occurrence records for some species, affect the precision of species distribution models. Additionally, whilst the inclusion of plant traits makes outcome statements more robust, some of the trait data clusters were estimated through expert judgement rather than derived from primary data sources. Transparency of this issue was addressed through the inclusion of a confidence score. Nevertheless. it is hoped that future research can reduce the data absences, mitigating this limitation in subsequent analyses.

Importantly. this analysis is only relevant for London and should only be considered accurate for this area. Climate projections, even within the same scenario vary across the UK so tree suitability from this study should not be inferred for other parts of the country which often have less consequential projections.

Recommended species have only been taken from the database provided. Therefore, these are species that are comparatively under-represented within London but currently available. We have refrained from advocating novel species that are not available to avoid incentivising importation of plant material from beyond UK borders. As recommended by this report, we are seeking to work with UK tree nurseries to bring novel tree species into production in a sustainable and ethical way.

N.B. Executive summary placed at the front of the document.

Appendix 1 – Supplementary Data

To ensure transparency and repeatability of the analysis, the data cleaning stages are recorded here. First, we removed observations that were too high.

Box 1: Removed observation data

'Acizzia', 'Anacardiaceae', 'Araliaceae', 'Arecaceae', 'Arecales', 'Bignoniaceae', 'Biota', 'Cannabaceae', 'Caprifoliaceae', 'Celastraceae', 'Chlorophyta', 'Cudoniella acicularis', 'Cupressaceae', 'Digitalis purpurea', 'Ericales', 'Exochorda', 'Fabaceae', 'Fallopia baldschuanica', 'Fallopia japonica', 'Garryales', 'Geometridae', 'Gymnodinium chiastosporum', 'Gymnodiniaceae', 'Hippothoa', 'Homona coffearia', 'Ipimorpha subtusa', 'Lauraceae', 'Lythraceae', 'Melianthaceae', 'Moraceae', 'Myrtaceae', 'Oleaceae', 'Pica', 'Pinaceae', 'Pinales', 'Pinophyta', 'Pinopsida', 'Plantae', 'Rosa', 'Rosacea', 'Rutaceae', 'Sapindales', 'Saxifragaceae', 'Saxifragales', 'Subacronicta megacephala', 'Ulmaceae', 'Zabrachia tenella'

N.B. - Some records from these groups are included, but the observations were removed where only the botanical order or family information was included as such a coarse level of resolution is not helpful in subsequent analysis.

Next it was important to harmonise hybrid names in order that names were recorded in a consistent way so that the same hybrid was not recorded in two different ways (Box 2).

Box 2 : Harmonised hybrid names

"Arbutus unedo x andrachne = A. x andrachnoides" = "Arbutus x andrachnoides",
"Berberis darwinii x empetrifolia = B. x stenophylla" = "Berberis x stenophylla",
"Cotoneaster frigidus x salicifolius = C. x watereri" = "Cotoneaster x watereri",
"Cotoneaster salicifolius x dammeri = C. 'Hybridus Pendulus'" = "Cotoneaster Hybridus Pendulus",
"Cupressus macrocarpa x Xanthocyparis nootkatensis = X Cuprocyparis leylandi" = "X Cuprocyparis leylandii",
"Forsythia suspensa x viridissima = F. x intermedia" = "Forsythia x intermedia",
"Ilex aquifolium x perado = I. x altaclerensis" = "Ilex x altaclerensis",
"Laburnum anagyroides x alpinum = L. x watereri" = "Laburnum x watereri",
"Larix decidua x kaempferi = L. x marschlinsii" = "Larix x marschlinsii",
"Malus atrosanguinea x niedzwetskyana = M. x purpurea" = "Malus x purpurea",
"Malus baccata x prunifolia = M. x robusta" = "Malus x robusta",
"Osmanthus decorus x delavayi = O. x burkwoodii" = "Osmanthus x burkwoodii",

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"Platanus occidentalis x orientalis = P. x hispanica" = "Platanus x hispanica",
"Populus alba x tremula = P. x canescens" = "Populus x canescens",
"Populus balsamifera x deltoides = P. x jackii" = "Populus x jackii",
"Populus nigra x deltoides = P. x canadensis" = "Populus x canadensis",
"Populus nigra x laurifolia = P. x berolinensis" = "Populus x berolinensis",
"Prunus spinosa x domestica = P. x fruticans" = "Prunus x fruticans",
"Pterocarya fraxinifolia x stenoptera (P. x rehderiana)" = "Pterocarya x rehderiana",
"Quercus cerris x suber = Q. x crenata" = "Quercus x crenata",
"Salix alba x babylonica = S. x sepulcralis" = "Salix x sepulcralis",
"Salix euxina x alba = S. x fragilis" = "Salix x fragilis",
"Sorbus aucuparia x aria = S. x thuringiaca" = "Sorbus x thuringiaca",
"Tilia cordata x dasystyla = T. x euchlora" = "Tilia x euchlora",
"Tilia platyphyllos x cordata = T. x europaea" = "Tilia x europaea",
"Ulmus glabra x minor x plotii = U. x hollandica" = "Ulmus x hollandica",
"Viburnum farreri x grandiflorum = V. x bodnantense" = "Viburnum x bodnantense",
"Viburnum lantana x rhytidophyllum = V. x rhytidophylloides" = "Viburnum x rhytidophylloides"

As the analysis for this report cannot resolve cultivar resilience scores, the cultivars present in the dataframe were recoded to represent the species level.

Box 3: Cultivars recoded to species

"Acer platanoides 'Drummondii'" = "Acer platanoides",
"Acer platanoides 'Schwedleri'" = "Acer platanoides",
"Acer pseudoplatanus 'Brilliantissimum'" = "Acer pseudoplatanus",
"Acer pseudoplatanus 'Leopoldii'" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma erythrocarpum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma purpureum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma variegatum" = "Acer pseudoplatanus",
"Betula pendula 'Laciniata'" = "Betula pendula",
"Betula pubescens Ehrh. var. pubescens" = "Betula pubescens",
"Chamaecyparis lawsoniana 'Erecta Viridis'" = "Chamaecyparis lawsoniana",
"Cupressus arizonica var. glabra" = "Cupressus arizonica",
"Fagus sylvatica 'Asplenifolia'" = "Fagus sylvatica",
"Fagus sylvatica 'Dawyck'" = "Fagus sylvatica",
"Fagus sylvatica 'Pendula'" = "Fagus sylvatica",

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"Fagus sylvatica 'Purpurea'" = "Fagus sylvatica",
"Fagus sylvatica Heterophylla group" = "Fagus sylvatica",
"Fraxinus angustifolia 'Raywood'" = "Fraxinus angustifolia",
"Fraxinus angustifolia subsp. oxycarpa" = "Fraxinus angustifolia",
"Fraxinus excelsior 'Diversifolia'" = "Fraxinus excelsior",
"Fraxinus excelsior 'Jaspidea'" = "Fraxinus excelsior",
"Mespilus germanica 'Nottingham'" = "Mespilus germanica",
"Pinus contorta var. latifolia" = "Pinus contorta",
"Pinus nigra subsp. laricio" = "Pinus nigra",
"Platanus" = "Platanus x hispanica",
"Populus candicans" = "Populus x candicans",
"Populus candicans 'Aurora'" = "Populus x candicans",
"Populus nigra 'Italica'" = "Populus nigra",
"Populus nigra 'Plantierensis'" = "Populus nigra",
"Populus nigra subsp. betulifolia" = "Populus nigra",
"Populus x canadensis 'Marilandica'" = "Populus x canadensis",
"Populus x canadensis 'Regenerata'" = "Populus x canadensis",
"Populus x canadensis 'Serotina'" = "Populus x canadensis",
"Prunus avium 'Plena'" = "Prunus avium",
"Prunus cerasifera var. pissardii" = "Prunus cerasifera",
"Prunus domestica subsp. insititia" = "Prunus domestica",
"Prunus Maackii" = "Prunus maackii",
"Quercus robur forma fastigiata" = "Quercus robur",
"Salix cinerea subsp. oleifolia" = "Salix cinerea",
"Salix x sepulcralis 'Chrysocoma'" = "Salix x sepulcralis",
"Taxodium" = "Taxodium distichum",
"Taxus baccata 'Fastigiata'" = "Taxus baccata",
"Tilia platyphyllos 'Rubra'" = "Tilia platyphyllos",
"Tilia 'Petiolaris'" = "Tilia tomentosa",
"Tilia tomentosa 'Petiolaris'" = "Tilia tomentosa",
"Ulmus glabra 'Exoniensis'" = "Ulmus glabra",
"Ulmus glabra 'Horizontalis' (Pendula)" = "Ulmus glabra",
"Ulmus minor agg." = "Ulmus minor",
"Ulmus minor subsp. minor" = "Ulmus minor"
"X Cuprocyparis" = "X Cuprocyparis leylandii",
"X Cupressocyparis" = "X Cuprocyparis leylandii",
"X Cuprocyparis leylandi" = "X Cuprocyparis leylandii",
"Yucca" = "Yucca filamentosa"
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Finally, the shrub and climber species were removed.

Box 4: Shrub and climber observations that have been removed

'Azara', 'Berberis darwinii', 'Berberis x stenophylla', 'Berberis . x stenophylla', 'Buddleja', 'Buddleja alternifolia', 'Buddleja davidii', 'Camelina', 'Camellia', 'Ceanothus', 'Cordyline australis', 'Corylus avellana', 'Corylus maxima', 'Cotinus', 'Cotinus coggygria', 'Cotoneaster', 'Cotoneaster Hybridus Pendulus', 'Cotoneaster conspicuus', 'Cotoneaster franchetii', 'Cotoneaster integrifolius', 'Cotoneaster salicifolius', 'Cotoneaster x watereri', 'Cytisus', 'Cytisus battandieri', 'Cytisus scoparius', 'Elaeagnus umbellata', 'Euonymus europaeus', 'Euonymus japonicus', 'Euonymus latifolius', 'Forsythia', 'Forsythia x intermedia', 'Frangula alnus', 'Fremontodendron californicum', 'Genista aetnensis', 'Genista hispanica', 'Griselinia', 'Griselinia littoralis', 'Hedera', 'Hedera helix', 'Homona coffearia', 'Hippophae rhamnoides', 'Ligustrum ovalifolium', 'Ligustrum vulgare', 'Lonicera periclymenum', 'Luma apiculata', 'Mahonia', 'Osmanthus', 'Osmanthus heterophyllus', 'Osmanthus x burkwoodii', 'Philadelphus', 'Philadelphus coronarius', 'Phillyrea latifolia', 'Photinia', 'Photinia davidiana', 'Pittosporum', 'Pittosporum tenuifolium', 'Pyracantha', 'Pyracantha atalantoides', 'Pyracantha coccinea', 'Rhamnus', 'Rhamnus cathartica', 'Rhododendron', 'Rhododendron ponticum', 'Ribes', 'Ribes sanguineum', 'Rosa canina', 'Rosa rugosa', 'Rubus cockburnianus', 'Rubus fruticosus agg.', 'Sambucus nigra', 'Viburnum', 'Viburnum davidii', 'Viburnum lantana', 'Viburnum opulus', 'Viburnum rhytidophyllum', 'Viburnum tinus', 'Viburnum x bodnantense', 'Viburnum x rhytidophylloides', Viburnum lantana x rhytidophyllum', 'Viburnum farreri x grandiflorum', 'Viburnum lantana x rhytidophyllum', 'Viburnum farreri x grandiflorum ', 'Viburnum lantana x rhytidophyllum', 'Wisteria sinensis'.

Table A1: List of tree species in London's public realm trees with relative counts and percentage data. Data is ordered alphabetically by family name. N.B. Some of the 'Species' are recorded as Genus, but these have been preserved as 'Species' to give a more accurate summary of the dataset.

Family [TaxonFamily]	Species [TaxonName]	Count of species	Percentage of species
Altingiaceae	*Liquidambar styraciflua*	9562	0.8
Anacardiaceae	*Rhus typhina*	351	0.03
Aquifoliaceae	*Ilex*	1276	0.1
Aquifoliaceae	*Ilex aquifolium*	13706	1.2
Aquifoliaceae	*Ilex x altaclerensis*	849	0.07
Araliaceae	*Aralia elata*	16	0.001
Araucariaceae	*Araucaria araucana*	103	0.009
Araucariaceae	*Wollemia nobilis*	7	0.0006
Arecaceae	*Phoenix dactylifera*	3	0.0003
Arecaceae	*Trachycarpus fortunei*	94	0.008
Asparagaceae	*Yucca filamentosa*	11	0.0009
Betulaceae	*Alnus*	941	0.08
Betulaceae	*Alnus cordata*	6183	0.5
Betulaceae	*Alnus glutinosa*	5945	0.5
Betulaceae	*Alnus incana*	2270	0.2
Betulaceae	*Alnus rubra*	137	0.01
Betulaceae	*Alnus viridis*	28	0.002
Betulaceae	*Betula*	10566	0.9
Betulaceae	*Betula alba*	26	0.002
Betulaceae	*Betula albosinensis*	1595	0.1
Betulaceae	*Betula jacquemontii*	2550	0.2
Betulaceae	*Betula lenta*	26	0.002
Betulaceae	*Betula maximowiczii*	84	0.007

Betulaceae	*Betula nana*	1	0.0001
Betulaceae	*Betula nigra*	1291	0.1
Betulaceae	*Betula papyrifera*	1760	0.2
Betulaceae	*Betula pendula*	31530	2.7
Betulaceae	*Betula pubescens*	3984	0.3
Betulaceae	*Betula utilis*	6920	0.6
Betulaceae	*Carpinus betulus*	35029	3.0
Betulaceae	*Corylus colurna*	6022	0.5
Betulaceae	*Ostrya carpinifolia*	662	0.06
Bignoniaceae	*Catalpa bignonioides*	1648	0.1
Bignoniaceae	*Chitalpa taschkentensis*	158	0.01
Buxaceae	*Buxus sempervirens*	211	0.02
Cannabaceae	*Celtis australis*	1411	0.1
Celastraceae	*Euonymus*	10	0.0009
Cercidiphyllaceae	*Cercidiphyllum japonicum*	257	0.02
Cornaceae	*Cornus*	256	0.02
Cornaceae	*Cornus alba*	49	0.004
Cornaceae	*Cornus alternifolia*	1	0.0001
Cornaceae	*Cornus florida*	6	0.0005
Cornaceae	*Cornus kousa*	124	0.01
Cornaceae	*Cornus mas*	509	0.04
Cornaceae	*Cornus sanguinea*	52	0.004
Cornaceae	*Davidia involucrata*	149	0.01
Cupressaceae	*Austrocedrus chilensis*	1	0.0001
Cupressaceae	*Calocedrus decurrens*	94	0.008
Cupressaceae	*Chamaecyparis*	865	0.07
Cupressaceae	*Chamaecyparis lawsoniana*	8314	0.7

Cupressaceae	*Chamaecyparis obtusa*	48	0.004
Cupressaceae	*Chamaecyparis pisifera*	26	0.002
Cupressaceae	*Cryptomeria japonica*	96	0.008
Cupressaceae	*Cupressus*	3809	0.3
Cupressaceae	*Cupressus arizonica*	15	0.001
Cupressaceae	*Cupressus lawsoniana*	210	0.02
Cupressaceae	*Cupressus macrocarpa*	709	0.06
Cupressaceae	*Cupressus sempervirens*	63	0.005
Cupressaceae	*X Cuprocyparis leylandii*	5777	0.5
Cupressaceae	*Hesperocyparis glabra*	78	0.007
Cupressaceae	*Juniperus*	90	0.008
Cupressaceae	*Juniperus chinensis*	26	0.002
Cupressaceae	*Juniperus communis*	126	0.01
Cupressaceae	*Juniperus virginiana*	26	0.002
Cupressaceae	*Metasequoia glyptostroboides*	1429	0.1
Cupressaceae	*Platycladus orientalis*	15	0.001
Cupressaceae	*Sequoia sempervirens*	194	0.02
Cupressaceae	*Sequoiadendron giganteum*	541	0.05
Cupressaceae	*Taxodium distichum*	475	0.04
Cupressaceae	*Thuja*	67	0.006
Cupressaceae	*Thuja occidentalis*	16	0.001
Cupressaceae	*Thuja plicata*	1546	0.1
Cupressaceae	*Thujopsis dolabrata*	6	0.0005
Cupressaceae	*Xanthocyparis nootkatensis*	30	0.003
Dicksoniaceae	*Dicksonia antarctica*	4	0.0003
Elaeagnaceae	*Elaeagnus angustifolia*	18	0.002
Elaeagnaceae	*Hippophae*	57	0.005

Ericaceae	*Arbutus unedo*	275	0.02
Fabaceae	*Acacia*	120	0.01
Fabaceae	*Acacia dealbata*	17	0.001
Fabaceae	*Acacia melanoxylon*	4	0.0003
Fabaceae	*Acacia pravissima*	2	0.0002
Fabaceae	*Caragana arborescens*	2	0.0002
Fabaceae	*Cercis siliquastrum*	784	0.07
Fabaceae	*Gleditsia triacanthos*	4073	0.3
Fabaceae	*Laburnum*	264	0.02
Fabaceae	*Laburnum alpinum*	4	0.0003
Fabaceae	*Laburnum anagyroides*	866	0.07
Fabaceae	*Laburnum x watereri*	177	0.02
Fabaceae	*Robinia pseudoacacia*	13208	1.1
Fabaceae	*Sophora microphylla*	1	0.0001
Fabaceae	*Sophora tetraptera*	12	0.001
Fabaceae	*Styphnolobium japonicum*	37	0.003
Fabaceae	*Ulex europaeus*	1	0.0001
Fagaceae	*Castanea sativa*	5710	0.5
Fagaceae	*Fagus*	136	0.01
Fagaceae	*Fagus orientalis*	9	0.0008
Fagaceae	*Fagus sylvatica*	10478	0.9
Fagaceae	*Quercus*	4181	0.4
Fagaceae	*Quercus alba*	2	0.0002
Fagaceae	*Quercus castaneifolia*	82	0.007
Fagaceae	*Quercus cerris*	3725	0.3
Fagaceae	*Quercus coccinea*	341	0.03
Fagaceae	*Quercus frainetto*	163	0.01

Fagaceae	*Quercus ilex*	2953	0.3
Fagaceae	*Quercus imbricaria*	1	0.0001
Fagaceae	*Quercus palustris*	987	0.08
Fagaceae	*Quercus petraea*	344	0.03
Fagaceae	*Quercus phellos*	28	0.002
Fagaceae	*Quercus phillyreoides*	1	0.0001
Fagaceae	*Quercus pubescens*	1	0.0001
Fagaceae	*Quercus robur*	66892	5.7
Fagaceae	*Quercus rubra*	2580	0.2
Fagaceae	*Quercus suber*	112	0.01
Fagaceae	*Quercus velutina*	2	0.0002
Fagaceae	*Quercus x crenata*	45	0.004
Fagaceae	*Quercus x turneri*	38	0.003
Garryaceae	*Garrya elliptica*	17	0.001
Ginkgoaceae	*Ginkgo biloba*	5524	0.5
Hamamelidaceae	*Parrotia persica*	1528	0.1
Juglandaceae	*Carya*	127	0.01
Juglandaceae	*Carya cordiformis*	2	0.0002
Juglandaceae	*Carya illinoensis*	2	0.0002
Juglandaceae	*Carya ovata*	8	0.0007
Juglandaceae	*Juglans*	25	0.002
Juglandaceae	*Juglans nigra*	521	0.04
Juglandaceae	*Juglans regia*	1424	0.1
Juglandaceae	*Pterocarya*	9	0.0008
Juglandaceae	*Pterocarya fraxinifolia*	393	0.03
Juglandaceae	*Pterocarya x rehderiana*	11	0.0009
Lamiaceae	*Clerodendrum trichotomum*	202	0.02

Lauraceae	*Laurus*	76	0.007
Lauraceae	*Laurus nobilis*	1058	0.09
Lauraceae	*Persea americana*	2	0.0002
Lauraceae	*Umbellularia californica*	4	0.0003
Magnoliaceae	*Liriodendron tulipifera*	2529	0.2
Magnoliaceae	*Magnolia*	4276	0.4
Magnoliaceae	*Magnolia acuminata*	12	0.001
Magnoliaceae	*Magnolia grandiflora*	31	0.003
Malvaceae	*Hibiscus syriacus*	435	0.04
Malvaceae	*Tilia*	21562	1.8
Malvaceae	*Tilia americana*	171	0.01
Malvaceae	*Tilia cordata*	17314	1.5
Malvaceae	*Tilia platyphyllos*	11252	1.0
Malvaceae	*Tilia tomentosa*	1123	0.1
Malvaceae	*Tilia x euchlora*	5036	0.4
Malvaceae	*Tilia x europaea*	45204	3.9
Moraceae	*Broussonetia papyrifera*	24	0.002
Moraceae	*Ficus carica*	437	0.04
Moraceae	*Morus*	13	0.001
Moraceae	*Morus alba*	342	0.03
Moraceae	*Morus nigra*	393	0.03
Myrtaceae	*Eucalyptus*	204	0.02
Myrtaceae	*Eucalyptus coccifera*	28	0.002
Myrtaceae	*Eucalyptus globulus*	10	0.0009
Myrtaceae	*Eucalyptus gunnii*	620	0.05
Myrtaceae	*Eucalyptus niphophila*	33	0.003
Myrtaceae	*Eucalyptus pauciflora*	2	0.0002

Myrtaceae	*Eucalyptus perriniana*	1	0.0001
Nothofagaceae	*Nothofagus*	27	0.002
Nothofagaceae	*Nothofagus alpina*	11	0.0009
Nothofagaceae	*Nothofagus antarctica*	149	0.01
Nothofagaceae	*Nothofagus dombeyi*	17	0.001
Nothofagaceae	*Nothofagus obliqua*	73	0.006
Nyssaceae	*Nyssa sylvatica*	147	0.01
Oleaceae	*Fraxinus*	6544	0.6
Oleaceae	*Fraxinus americana*	365	0.03
Oleaceae	*Fraxinus angustifolia*	1858	0.2
Oleaceae	*Fraxinus excelsior*	53362	4.6
Oleaceae	*Fraxinus latifolia*	15	0.001
Oleaceae	*Fraxinus ornus*	2461	0.2
Oleaceae	*Fraxinus pennsylvanica*	56	0.005
Oleaceae	*Fraxinus velutina*	7	0.0006
Oleaceae	*Ligustrum*	2042	0.2
Oleaceae	*Ligustrum lucidum*	1359	0.1
Oleaceae	*Ligustrum sinensis*	22	0.002
Oleaceae	*Olea europaea*	338	0.03
Oleaceae	*Syringa vulgaris*	729	0.06
Paulowniaceae	*Paulownia tomentosa*	589	0.05
Pinaceae	*Abies*	112	0.01
Pinaceae	*Abies alba*	109	0.009
Pinaceae	*Abies cephalonica*	3	0.0003
Pinaceae	*Abies concolor*	4	0.0003
Pinaceae	*Abies delavayi*	2	0.0002
Pinaceae	*Abies fraseri*	24	0.002

Pinaceae	*Abies grandis*	83	0.007
Pinaceae	*Abies koreana*	12	0.001
Pinaceae	*Abies lasiocarpa*	6	0.0005
Pinaceae	*Abies nordmanniana*	16	0.001
Pinaceae	*Abies procera*	35	0.003
Pinaceae	*Cedrus*	260	0.02
Pinaceae	*Cedrus atlantica*	1208	0.1
Pinaceae	*Cedrus brevifolia*	9	0.0008
Pinaceae	*Cedrus deodara*	813	0.07
Pinaceae	*Cedrus libani*	475	0.04
Pinaceae	*Larix*	115	0.01
Pinaceae	*Larix decidua*	464	0.04
Pinaceae	*Larix kaempferi*	49	0.004
Pinaceae	*Larix x marschlinsii*	42	0.004
Pinaceae	*Picea*	69	0.006
Pinaceae	*Picea abies*	537	0.05
Pinaceae	*Picea breweriana*	12	0.001
Pinaceae	*Picea glauca*	15	0.001
Pinaceae	*Picea obovata*	1	0.0001
Pinaceae	*Picea omorika*	56	0.005
Pinaceae	*Picea orientalis*	2	0.0002
Pinaceae	*Picea pungens*	45	0.004
Pinaceae	*Picea sitchensis*	11	0.0009
Pinaceae	*Picea smithiana*	4	0.0003
Pinaceae	*Pinus*	1045	0.09
Pinaceae	*Pinus cembra*	8	0.0007
Pinaceae	*Pinus contorta*	7	0.0006

Pinaceae	*Pinus mugo*	34	0.003
Pinaceae	*Pinus muricata*	1	0.0001
Pinaceae	*Pinus nigra*	3553	0.3
Pinaceae	*Pinus peuce*	6	0.0005
Pinaceae	*Pinus pinaster*	29	0.002
Pinaceae	*Pinus pinea*	254	0.02
Pinaceae	*Pinus ponderosa*	13	0.001
Pinaceae	*Pinus radiata*	106	0.009
Pinaceae	*Pinus strobus*	59	0.005
Pinaceae	*Pinus sylvestris*	5892	0.5
Pinaceae	*Pinus wallichiana*	123	0.01
Pinaceae	*Pinus x holfordiana*	7	0.0006
Pinaceae	*Pseudotsuga menziesii*	68	0.006
Pinaceae	*Tsuga*	2	0.0002
Pinaceae	*Tsuga canadensis*	3	0.0003
Pinaceae	*Tsuga heterophylla*	15	0.001
Platanaceae	*Platanus occidentalis*	23	0.002
Platanaceae	*Platanus orientalis*	822	0.07
Platanaceae	*Platanus x hispanica*	77569	6.6
Rosaceae	*Amelanchier*	7855	0.7
Rosaceae	*Amelanchier lamarckii*	3286	0.3
Rosaceae	*Amelanchier ovalis*	67	0.006
Rosaceae	*Cotoneaster frigidus*	415	0.04
Rosaceae	*Cotoneaster salicifolius*	8	0.0007
Rosaceae	*Crataegus*	5195	0.4
Rosaceae	*Crataegus coccinea*	6	0.0005
Rosaceae	*Crataegus crus-galli*	1245	0.1

Rosaceae	*Crataegus laevigata*	3163	0.3
Rosaceae	*Crataegus mollis*	25	0.002
Rosaceae	*Crataegus monogyna*	27542	2.4
Rosaceae	*Crataegus persimilis*	3007	0.3
Rosaceae	*Crataegus punctata*	3	0.0003
Rosaceae	*Crataegus succulenta*	8	0.0007
Rosaceae	*Crataegus x lavallei*	1874	0.2
Rosaceae	*Cydonia oblonga*	77	0.007
Rosaceae	*Hedlundia mougeotii*	11	0.0009
Rosaceae	*Malus*	25652	2.2
Rosaceae	*Malus baccata*	1350	0.1
Rosaceae	*Malus domestica*	75	0.006
Rosaceae	*Malus floribunda*	983	0.08
Rosaceae	*Malus hupehensis*	400	0.03
Rosaceae	*Malus niedzwetzkyana*	1	0.0001
Rosaceae	*Malus prunifolia*	118	0.01
Rosaceae	*Malus pumila*	1930	0.2
Rosaceae	*Malus robusta*	32	0.003
Rosaceae	*Malus sieboldii*	9	0.0008
Rosaceae	*Malus sylvestris*	2346	0.2
Rosaceae	*Malus x purpurea*	1672	0.1
Rosaceae	*Mespilus germanica*	540	0.05
Rosaceae	*Prunus*	87837	7.5
Rosaceae	*Prunus armeniaca*	2	0.0002
Rosaceae	*Prunus avium*	31803	2.7
Rosaceae	*Prunus cerasifera*	21472	1.8
Rosaceae	*Prunus cerasus*	59	0.005

Rosaceae	Prunus domestica	1622	0.1
Rosaceae	Prunus dulcis	586	0.05
Rosaceae	Prunus incisa	68	0.006
Rosaceae	Prunus laurocerasus	1912	0.2
Rosaceae	Prunus lusitanica	808	0.07
Rosaceae	Prunus maackii	539	0.05
Rosaceae	Prunus padus	4936	0.4
Rosaceae	Prunus persica	25	0.002
Rosaceae	Prunus serotina	29	0.002
Rosaceae	Prunus serrulata	12436	1.1
Rosaceae	Prunus spinosa	1856	0.2
Rosaceae	Prunus x fruticans	2157	0.2
Rosaceae	Pyrus	22769	1.9
Rosaceae	Pyrus calleryana	2701	0.2
Rosaceae	Pyrus communis	2790	0.2
Rosaceae	Pyrus cordata	7	0.0006
Rosaceae	Pyrus pyraster	5	0.0004
Rosaceae	Pyrus salicifolia	301	0.03
Rosaceae	Sorbaria tomentosa	2	0.0002
Rosaceae	Sorbus	8473	0.7
Rosaceae	Sorbus 'Joseph Rock'	182	0.02
Rosaceae	Sorbus aria	12600	1.1
Rosaceae	Sorbus aucuparia	17829	1.5
Rosaceae	Sorbus commixta	514	0.04
Rosaceae	Sorbus domestica	149	0.01
Rosaceae	Sorbus glabriuscula	242	0.02
Rosaceae	Sorbus intermedia	9788	0.8

Rosaceae	*Sorbus latifolia*	200	0.02
Rosaceae	*Sorbus pseudohupehensis*	12	0.001
Rosaceae	*Sorbus sargentiana*	19	0.002
Rosaceae	*Sorbus thibetica*	15	0.001
Rosaceae	*Sorbus torminalis*	708	0.06
Rosaceae	*Sorbus vilmorinii*	16	0.001
Rosaceae	*Sorbus x thuringiaca*	1473	0.1
Rutaceae	*Citrus trifoliata*	6	0.0005
Salicaceae	*Populus*	5396	0.5
Salicaceae	*Populus alba*	2599	0.2
Salicaceae	*Populus balsamifera*	691	0.06
Salicaceae	*Populus canescens*	274	0.02
Salicaceae	*Populus deltoides*	1	0.0001
Salicaceae	*Populus laurifolia*	3	0.0003
Salicaceae	*Populus nigra*	8481	0.7
Salicaceae	*Populus tremula*	1756	0.2
Salicaceae	*Populus tremuloides*	21	0.002
Salicaceae	*Populus trichocarpa*	65	0.006
Salicaceae	*Populus x berolinensis*	1	0.0001
Salicaceae	*Populus x canadensis*	1240	0.1
Salicaceae	*Populus x candicans*	54	0.005
Salicaceae	*Populus x canescens*	707	0.06
Salicaceae	*Populus x jackii*	30	0.003
Salicaceae	*Populus yunnanensis*	1	0.0001
Salicaceae	*Salix*	4499	0.4
Salicaceae	*Salix alba*	2768	0.2
Salicaceae	*Salix babylonica*	1513	0.1

Salicaceae	*Salix caprea*	3030	0.3
Salicaceae	*Salix cinerea*	68	0.006
Salicaceae	*Salix daphnoides*	9	0.0008
Salicaceae	*Salix matsudana*	260	0.02
Salicaceae	*Salix pentandra*	14	0.001
Salicaceae	*Salix viminalis*	2	0.0002
Salicaceae	*Salix x fragilis*	2773	0.2
Salicaceae	*Salix x pendulina*	1	0.0001
Salicaceae	*Salix x sepulcralis*	129	0.01
Sapindaceae	*Acer*	8417	0.7
Sapindaceae	*Acer campestre*	31019	2.7
Sapindaceae	*Acer cappadocicum*	1411	0.1
Sapindaceae	*Acer davidii*	290	0.02
Sapindaceae	*Acer griseum*	176	0.02
Sapindaceae	*Acer hersii*	5	0.0004
Sapindaceae	*Acer japonicum*	79	0.007
Sapindaceae	*Acer macrophyllum*	4	0.0003
Sapindaceae	*Acer monspessulanum*	40	0.003
Sapindaceae	*Acer negundo*	2433	0.2
Sapindaceae	*Acer opalus*	9	0.0008
Sapindaceae	*Acer palmatum*	368	0.03
Sapindaceae	*Acer platanoides*	55775	4.8
Sapindaceae	*Acer pseudoplatanus*	52510	4.5
Sapindaceae	*Acer rubrum*	1252	0.1
Sapindaceae	*Acer rufinerve*	28	0.002
Sapindaceae	*Acer saccharinum*	6275	0.5
Sapindaceae	*Acer saccharum*	800	0.07

Sapindaceae	*Acer tataricum*	9	0.0008
Sapindaceae	*Aesculus*	569	0.05
Sapindaceae	*Aesculus flava*	163	0.01
Sapindaceae	*Aesculus hippocastanum*	23652	2.0
Sapindaceae	*Aesculus indica*	1001	0.09
Sapindaceae	*Aesculus parviflora*	9	0.0008
Sapindaceae	*Aesculus pavia*	45	0.004
Sapindaceae	*Aesculus turbinata*	4	0.0003
Sapindaceae	*Aesculus x carnea*	2194	0.2
Sapindaceae	*Koelreuteria paniculata*	1633	0.1
Simaroubaceae	*Ailanthus altissima*	3795	0.3
Styracaceae	*Styrax japonicus*	7	0.0006
Tamaricaceae	*Tamarix*	37	0.003
Tamaricaceae	*Tamarix africana*	26	0.002
Tamaricaceae	*Tamarix gallica*	29	0.002
Tamaricaceae	*Tamarix parviflora*	14	0.001
Tamaricaceae	*Tamarix tetrandra*	85	0.007
Taxaceae	*Cephalotaxus fortunei*	12	0.001
Taxaceae	*Taxus baccata*	8982	0.8
Ulmaceae	*Ulmus*	4332	0.4
Ulmaceae	*Ulmus glabra*	1008	0.09
Ulmaceae	*Ulmus laevis*	28	0.002
Ulmaceae	*Ulmus minor*	340	0.03
Ulmaceae	*Ulmus procera*	5951	0.5
Ulmaceae	*Ulmus x hollandica*	119	0.01
Ulmaceae	*Zelkova*	12	0.001
Ulmaceae	*Zelkova carpinifolia*	198	0.02

Ulmaceae	*Zelkova serrata*	789	0.07

APPENDIX 2

We could add the 101 TDAG Species profiles for the suitable (high and moderate suitability) species. Thoughts welcome.

High suitability species

1. *Acer monspessulanum,*
2. *Acer tataricum,*
3. *Arbutus unedo,*
4. *Cupressus arizonica,*
5. *Cupressus macrocarpa,*
6. *Eucommia ulmoides,*
7. *Olea europaea,*
8. *Ostrya carpinifolia,*
9. *Parrotia persica,*
10. *Quercus frainetto,*
11. *Quercus ilex,*
12. *Quercus suber,*
13. ***Sorbus torminalis**,*
14. *Tamarix ramosissima*

Moderate suitability species

1. *Abies concolor,*
2. *Acacia dealbata,*
3. *Acer buergerianum,*
4. *Acer cappadocicum,*
5. *Acer davidii,*
6. *Acer griseum,*
7. *Acer negundo,*
8. *Aesculus indica,*
9. *Aesculus pavia,*
10. *Amelanchier alnifolia,*
11. *Betula albosinensis,*
12. *Betula jacquemontii,*
13. *Betula papyrifera,*
14. *Betula utilis,*
15. *Buxus sempervirens,*
16. *Carya illinoinensis,*
17. *Catalpa bignonioides,*
18. *Catalpa speciosa,*
19. *Cedrus atlantica,*
20. *Cedrus deodara,*
21. *Cedrus libani,*
22. *Celtis australis,*
23. *Celtis occidentalis,*
24. *Cercis siliquastrum,*
25. *Chamaecyparis lawsoniana,*
26. *Corylus colurna,*
27. *Corylus maxima,*
28. *Crataegus x lavallei,*

29. ***Crataegus monogyna***,
30. *Crataegus x persimilis*,
31. *Cupressus sempervirens*,
32. *Cydonia oblonga*,
33. *Diospyros kaki*,
34. *Elaeagnus angustifolia*,
35. *Eucalyptus pauciflora*,
36. *Fagus orientalis*,
37. *Ficus carica*,
38. *Ginkgo biloba*,
39. *Gleditsia triacanthos*,
40. *Gymnocladus dioica*,
41. *Heptacodium miconioides*,
42. *Hippophae salicifolia*,
43. *Juglans nigra*,
44. *Juglans regia*,
45. *Juniperus scopulorum*,
46. *Juniperus virginiana*,
47. *Koelreuteria paniculata*,
48. *Ligustrum japonicum*,
49. *Ligustrum lucidum*,
50. *Malus baccata*,
51. *Malus yunnanensis*,
52. *Morus alba*,
53. *Morus nigra*,
54. *Nothofagus antarctica*,
55. *Paulownia tomentosa*,
56. *Picea pungens*,
57. *Pinus contorta*
58. *Pinus nigra*,
59. *Pinus pinaster*,
60. *Pinus pinea*,
61. *Pinus radiata*,
62. *Pinus wallichiana*,
63. *Platanus x hispanica*,
64. *Platanus orientalis*,
65. *Pseudotsuga menziesii*
66. *Prunus cerasifera*,
67. *Prunus dulcis*,
68. *Prunus maackii*,
69. *Prunus serrula*,
70. *Pyrus calleryana*,
71. *Pyrus communis*,
72. *Quercus castaneifolia*,
73. *Robinia pseudoacacia*,
74. *Sequoia sempervirens*,
75. *Sequoiadendron giganteum*,
76. *Sorbus discolor*,
77. *Sorbus vilmorinii*,
78. *Styphnolobium japonicum*,

79. *Syringa vulgaris*,
80. *Syringa reticulata*,
81. *Tamarix gallica*,
82. *Tamarix tetrandra*,
83. *Taxodium distichum*,
84. ***Taxus baccata*,**
85. *Tilia mongolica*,
86. *Ulmus* (resistant cultivars),
87. *X Cuprocyparis leylandii*

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: RE: Impact of increased atmospheric CO2 level on tree water efficiency
Date: 22 October 2025 10:50:00

Dear both,

...in thinking a bit more about it, I think I am starting to see how BiFOR's findings and your approach sit together:

1. Drought tolerance and water efficiency are two different things, aren't they? So while trees might become more efficient with water, they still need to access water, and the point you are making is that under current climate scenarios, this is going to become more challenging.
2. Urban environments, such as London's exacerbate this. Unlike the forest environments where the Bifor work took place, London's trees often grow in restricted rooting environments with limited access to deep water reserves... If soil moisture is low due to poor infiltration, compacted soils, or seasonal drought, even water efficient trees will struggle.
3. The traits you have looked at are probably still relevant even under higher CO2 levels, for understanding how trees respond to combined stresses: heat, drought, pests?

...So maybe in your report it is a matter of acknowledging that while elevated CO2 may moderate some of the projected impacts, but it won't altogether eliminate the risks posed by increased heat and reduced water availability?

And your emphasis on provenance - selecting tree populations from regions already coping with hotter, drier conditions, is really valid in the sense that it provides a way forward to identify trees may already possess the physiological traits needed to be the best able to benefit from elevated CO2 and tolerate water stress???

Is that right?

Best,

[redacted]
Senior Policy and Programme Officer
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City Hall, Kamal Chunchie Way, London E16 1ZE
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[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
Sent: 22 October 2025 10:21
To: [redacted] ; [redacted]
Cc: [redacted]
Subject: Impact of increased atmospheric CO2 level on tree water efficiency

Hi both,

There are good comments coming in on your draft report – which I am collating and will share on Friday.

One observation I feel is worth passing on straight away is from University of Birmingham. An experiment coordinated by Anna Gardner at BiFOR has demonstrated across several sites around the world and a broad range of species that trees living in conditions where the carbon

dioxide (CO2) has been artificially elevated (to mimic atmospheric conditions expected to be the norm by 2050) are likely to become more efficient in conserving water. The trees under increased CO_2 treatment were able to increase their water use efficiency by increasing their carbon uptake whilst, simultaneously, conserving water by adjusting the opening and closing of their stomata. The researchers found that, overall, the efficiency of water use in the trees' leaves increased by 85% for a doubling of CO_2 and that contrary to previous assumptions, these responses were similar across all the tree types studied (compared to pre-industrial average). You are most likely already fully aware of this work

- Gardner et al (2023). 'Optimal stomatal theory predicts CO_2 responses of stomatal conductance in both gymnosperm and angiosperm trees.' *New Phytologist*.
- Plain English overview of findings: Forest trees find a new watery 'sweet spot' when CO2 is high - University of Birmingham

My (lay person) question is: how does your approach account for these findings? It seems worth acknowledging them somewhere in your report and spelling out how your approach accounts for them or can stand alongside of them.

The fact is, currently, trees around us are clearly showing signs of increased drought stress (despite increasing CO2 levels…) – will this still be the case with much higher atmospheric CO2?

Best,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]london.gov.uk
My pronouns are: [redacted]

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: RE: Feedback on report
Date: 30 October 2025 07:25:00
Attachments: UPL DRAFT Final Report October 2025_AJ.docx

Hi [redacted]
Here it is.,
Headline comments:

- Everybody who commented really, really praised the quality of the work.
- A large number of people indicated that they had to look up a number of words / terms in order to be able to follow. There is a need to explain these terms as you go along. I have tried to help with this – both via proposed edits to the body text and through the proposed addition of a number of sidebars.
- Some editing of the style is needed to enhance readability – I have taken a serious crack at this. If I have inadvertently changed the meaning somewhere: please do rectify!
- To make the recommendations punchier/easier to interpret, Georgie propose a really good set of action bullets. Please here again ensure that these accurately reflect your position.
- People love the graphics: they need to be displayed big – to be easier to read.
- As a fundamental message – while we want to present the data, I think it is useful to really highlight that this is not a forecast of doom: there is scope (and some time) to act – and as such this report is a fantastic tool to equip all for action. You will see we have tried to pull this to the fore in the executive summary (Which I have inserted).
- We need to ensure there is no ambiguity that these findings are London specific and cannot be extrapolated. You do say that, but only at the end. I have made suggestions on how to bring it more forward.
- How the approach you recommend can sit alongside with and a more ecosystems-led/conservationist approach like the Woodland Trust's is worth addressing somewhere.

I am in training all day today but available tomorrow to discuss.
Best,

[redacted]
Senior Policy and Programme Officer
GREATER**LONDON**AUTHORITY
City Hall, Kamal Chunchie Way, London E16 1ZE
www.london.gov.uk
[redacted]

From: [redacted]
Sent: 28 October 2025 15:46
To: [redacted]
Subject: Feedback on report

H[redacted]
I[redacted] Are you able to provide the collated feedback from key stakeholders so that I can work on any necessary revisions…
Thanks,

[redacted] Outlook for iOS

OCTOBER 10, 2025

Commented [1]: Cover image suggestions welcome.

Commented [ ]: 2 Suggestions:

1)London Skyline image with green space in the foreground, split down the middle, with the right hand side turned into two-tone.
2)IMG100495.jpg, credit Mark Lee.

Commented [ ]: Insert Supported by Mayor of London and Forestry Commission logos

FUTURE CLIMATE SUITABILITY OF LONDON'S PUBLIC REALM TREES

FINAL REPORT

ANDREW HIRONS AND KEVIN MARTIN
URBAN PLANT LAB

URBAN PLANT LAB

Add page for front matter: authors, acknowledgements, funders, contents…

[redacted] [redacted] and team – What about a Forward? If so, who should write it?

Commented [redacted]: No forward.

Document to be subject to graphic design, however, here it is left in Word format for ease of collecting feedback from key stakeholders.

URBAN PLANT LAB

Executive Summary

~~To be completed after review process.~~

Trees in London's public spaces — parks, streets, squares — play a vital role in making the city healthier, cooler, and more liveable for both people and wildlife. However, as the climate changes, life will become more challenging for many of these trees.

This report, commissioned by the Greater London Authority and the Forestry Commission, assesses how well London's public realm tree are likely to cope with projected climate conditions in 2090.

London is the first city in the world to commission such comprehensive climate suitability assessment of its public trees. This puts London on the front foot, with the evidence needed to act early and strategically.

Findings from this research are specific to London and its urban microclimate. They should not be applied to other cities or regions, even within the UK, as climate projections and growing conditions vary significantly.

Key Findings

- **If no changes are made**, in total, over **70% of London's public trees** may struggle to thrive or survive as the climate changes.
- Only **0.38%** of trees are considered **highly suitable** for future climate conditions.
- **22%** have **moderate suitability** — they may cope and could perform better with improved sourcing of planting material.
- **62%** are rated as **low suitability** — they are likely to struggle, though careful sourcing may improve outcomes.
- **10.6%** are considered **vulnerable**, with no evidence of thriving under future climate conditions, even with improved sourcing.

How the assessment was done

The study analysed data from over **1.1 million public trees** across London. Each species was assessed for its suitability to London's projected climate in 2090 using a composite scoring system that combined global species distribution data and plant trait analysis.

Species were grouped into four climate suitability categories:

- **High suitability**: Likely to thrive under future conditions.
- **Moderate suitability**: May perform well, especially if sourced from regions with compatible climates.
- **Low suitability**: Expected to struggle, though some improvement may be possible through careful sourcing.
- **Vulnerable**: Unlikely to survive or thrive, with no evidence of success in similar climates.

Why this Matters

Trees that are poorly suited to future conditions may grow slowly, be more vulnerable to pests and diseases, and die prematurely — reducing the many benefits they provide.

Publicly owned trees deliver around **60% of the ecosystem services** — including cooling, air purification, and stormwater management, London's urban forest provide. The resilience of London's overall public tree population is critical to sustaining the environmental and cultural benefits Londoners rely on.

Recommendations

To protect London's urban forest, the report recommends:

- **Improving growing conditions** for existing trees.
- **Planting more climate-suitable species**, and where appropriate, select **provenances** better adapted to future conditions.
- **Funding tree establishment**, not just planting, to ensure long-term survival.
- **Adopting a London-wide tree data standard** to improve monitoring and planning.
- **Collaborating with nurseries** to ensure the right species and provenances are available and grown for London's future climate.
- **Supporting innovation in nursery production** through national government incentives and industry partnerships.
- **Investing in research** to improve plant trait data.
- **Coordinating across boroughs** for a coherent approach to urban forest management.
- **Sharing this approach to climate suitability assessment with other cities**, while tailoring it to their specific climates.

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Commented [AH5]: This is a big sentence, consider breaking up

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Commented [redacted]: Do you mean the resilience of the overall public tree stock - or the resilience of the existing trees. Slightly changes the implication of this sentence so good to make it clear. I think our message is that a public tree stock is critical, and that to ensure its continuity it will have to be shaped (and therefore the existing trees themselves aren't necessarily critical in that)

Conclusions

Ensuring the resilience of London's urban forest requires **collective action**:

- **Strategic authorities**, such as the GLA, have a key role in **convening stakeholders, disseminating knowledge**, and **coordinating pan-London responses**.
- **London boroughs and other public realm tree managers** are key to choosing the right mix of trees for each site and can use their **buying powers strategically** to encourage nurseries to grow trees — and provenances — suited to London's future climate.
- **Nurseries and the wider horticultural industry**, have a critical role to play in leading innovation. By partnering with councils and researchers, **including botanic gardens** like Kew, they can help accelerate the availability of climate-resilient tree stock, including suitable provenances.
- **Grant-making bodies**, including government departments and the GLA, must ensure that **funding models support tree establishment**, not just planting.
- **Government bodies**, such as Defra, can incentivise innovation in nursery production and strengthen research and urban tree health monitoring.
- **Researchers** must continue improving data on plant traits and provenance to refine species selection and climate resilience.
- **Residents** can support tree establishment by volunteering to water newly planted trees.

By working together, we can ensure London's treescapes remain healthy, diverse, and deliver Londoners for generations to come.

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Commented [redacted]: I'm not sure about this one being fine. Feels like putting the onus on residents... and not necessarily the things that would make the biggest change?

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Introduction

London's urban forest contributes to the wellbeing of residents and visitors in manifold ways. Whilst as a whole, London's urban forest is taxonomically rich, relatively few species dominate. To support an agenda of strategic diversification, it is critical to evaluate the vulnerability of London's current tree stock to a changing climate. Therefore, the Greater London Authority and the Forestry Commission, on behalf of the London ~~'s~~ Urban Forest Partnership[1], commissioned an analysis of the likely suitability of London's trees to a future climate scenario. This directly supports the implementation of actions 1C and 1D ~~goal 1~~ of the London Urban Forest Plan and its Goal 1: Resilience ~~which states: *Enhance the resilience of London's urban forest to the threats posed by climate change, pests and diseases*~~.

Commented [redacted] Putting this first makes it read like the primary driver for the work. I think the primary driver for the work is retaining a healthy urban forest…..diversification being one of the strategies to do so. Consider rewording

Goal 1: Resilience - ~~-~~Enhance the resilience of London's urban forest ~~to~~ the threats posed by climate change, pests and diseases

Figure 1: This project directly supports the implementation of Goal 1 from the London Urban Forest Plan 2025 Actions Update[2] ~~directly relates to the objectives of this project~~.

Using collated tree inventory data from local authorities and other public realm tree managers within the Greater London Authority area, species comprising of 95% of London's public realm trees have been evaluated for their likely suitability to London's climate in 2090 under a SSP3[3] scenario.

Commented [redacted]]: Brief explanation of what SSP3 is would be helpful, ~~+~~refer to box I recommend providing on this later on.

The project objectives were to:

I. Determine the suitability of London's most important urban tree species to a future climate scenario.
II. Recommend strategic tree management objectives to mitigate climate-related risks to London's urban forest.

[1] See: www.london.gov.uk/programmes-strategies/environment-and-climate-change/parks-green-spaces-and-biodiversity/trees-and-woodlands/london-urban-forest-partnership
[2] Available at: www.london.gov.uk/media/107915/download~~London Urban Forest Plan – 2025 Actions Update~~
[3] Shared Socioeconomic Pathway 3 (Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I. and Huang, M., 2021. Climate change 2021: the physical science basis. *Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change*, *2*(1), p.2391. https://doi.org/10.1017/9781009157896)

Review of the taxonomic composition London's public realm trees.

The Greenspace Information for Greater London CIC provided a data cache compiling tree inventory data from 31 out of London's 33 boroughs, as well as from other landowners managing public realm trees in London such as Transport for London, the London Legacy Development Corporation, the Royal Parks and Wembley Park[4] ~~for most of London's boroughs and provided~~. This ~~a~~ dataset totalled ~~with~~ 1,187,924 observations. These data were cleaned to remove 19,574 observations that either recorded too high a taxonomic level or were not trees (details of removed observations can be found in Appendix 1 - Supplementary Data). Accordingly, the final dataset had 1,168,350 tree observations that were subject to analysis.

Commented [redacted]: Question for [redacted]: Would you like us to be specific about which boroughs submitted data?

Commented [redacted]: Please see my proposed edit. Please do double check the number of boroughs (I count the City Of London as a 'borough' in this total).

Public realm trees within London are taxonomically diverse and include 44 families, 110 genera and 375 species (Figure 2). Proportionally, the most important family is the *Rosaceae* (rose family); it accounts for 29% of public realm trees and contains important genera such as, cherries (*Prunus* (14%)), rowans (*Sorbus* (4%)) and hawthorns (*Crataegus* (4%)) (Figure 2). Other important genera are the maples (*Acer* (14%)), limes (*Tilia* (9%)), oaks (*Quercus* (7%)), planes (*Platanus* (7%)), ash (*Fraxinus* (6%)) and birch (*Betula* (5%)) (Figure 2). Interestingly, the cypress family (*Cupressaceae*) is represented by 15 different genera, yet only makes up around 2% of the urban forest.

At a species level, the most frequently observed species was '*Prunus*'. Of course, this is a genus rather than a species, so accurate taxonomic interpretation is challenging. However, when *Prunus* is recorded, surveyors are most likely referring to some type of flowering cherry. A similar lack of species resolution is apparent within numerous important genera. As it is impossible to determine the species composition of a pooled group, these genus-level 'species' have been preserved in the analysis: this will be a minor source of error. However, it is very unlikely that a major tree species has not been recorded, rather the relative proportions of some species may be slightly misrepresented. These errors could be removed through future surveying efforts and should motivate the introduction of a standardised data collection protocol across London.

London plane (*Platanus* x *hispanica* (7%)), pedunculate oak (*Quercus robur* (6%)), Norway maple (*Acer platanoides* (5%)), European ash (*Fraxinus excelsior* (5%)) and sycamore (*Acer pseudoplatanus* (5%)) are the most important species within London's public realm trees (Figure 3, 4, 5). A detailed breakdown of the taxonomic analysis is found in table A1 in Appendix 1.

[4] This dataset forms the backbone of the London Public Realm Tree Map available on the London Datastore. See: https://data.london.gov.uk/dataset/london-public-realm-trees-2r45m/

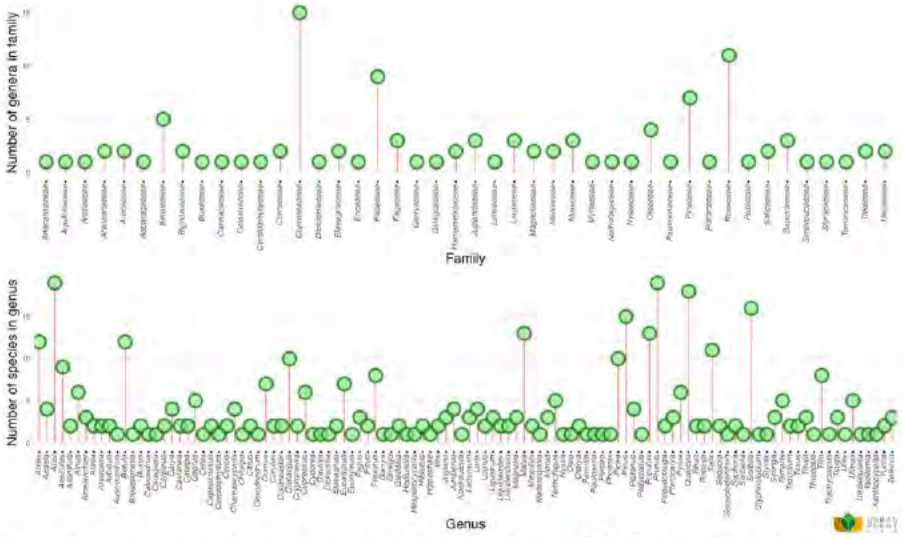

Figure 2: Taxonomic make up of London's public realm trees. Upper panel: number of genera represented by the 44 botanical families. Lower panel: number of species in each of the 110 genera.

Figure 3: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles; colour represents the botanical family. Labels are included for the 10 most represented family, labels for the less significant families are omitted for clarity.

Commented [redacted]: Please ensure all figures, particularly the block diagrams such as Fig 5 further below, are given ample space in the designed version of the report. Several reviewers have highlighted the need for these to be given full page width, preferably in a landscape orientation. Whatever the solution [redacted] finds: it needs to prioritise readability. This report will not be printed, so we are not precious about page count.

Figure 4: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles; colour represents the genus. Labels are included for the 10 most represented genera, labels for the less significant genera are omitted for clarity.

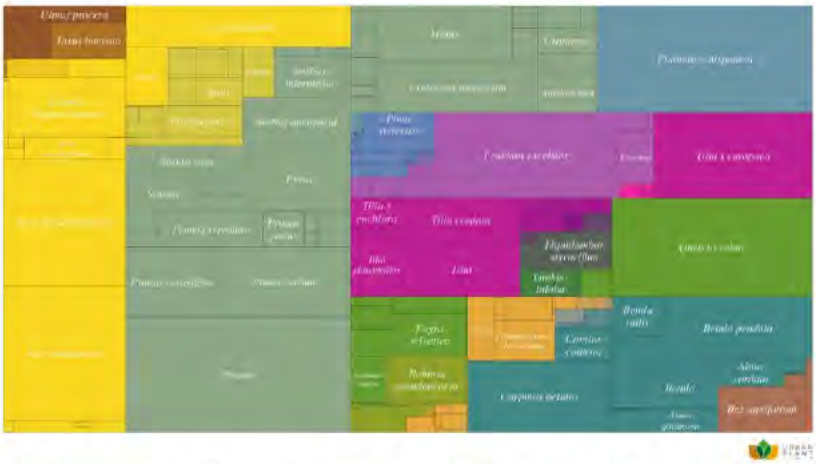

Figure 5: Representation of the taxonomic diversity of London's public realm trees. The size of the rectangles the population of the species; colour represents the botanical family. Labels are included for the 50 most represented species, labels for the less significant species are omitted for clarity.

Evaluating climate suitability for London's public realm trees.

London already experiences a significant urban heat island effect (Figure 6), which makes growing conditions challenging for many tree species — especially when combined with poor soil quality and limited rooting space. These pressures are expected to intensify under future climate scenarios (Figure 7).

~~It is clear that even under the current climate, London is already subject to a substantive urban heat island effect (Figure 6). This makes the growing environment for many tree species challenging, especially when combined with sub-optimal rooting environments. Under future climate scenarios the climate pressure with respect to tree growing conditions is set to intensify (Figure 7).~~

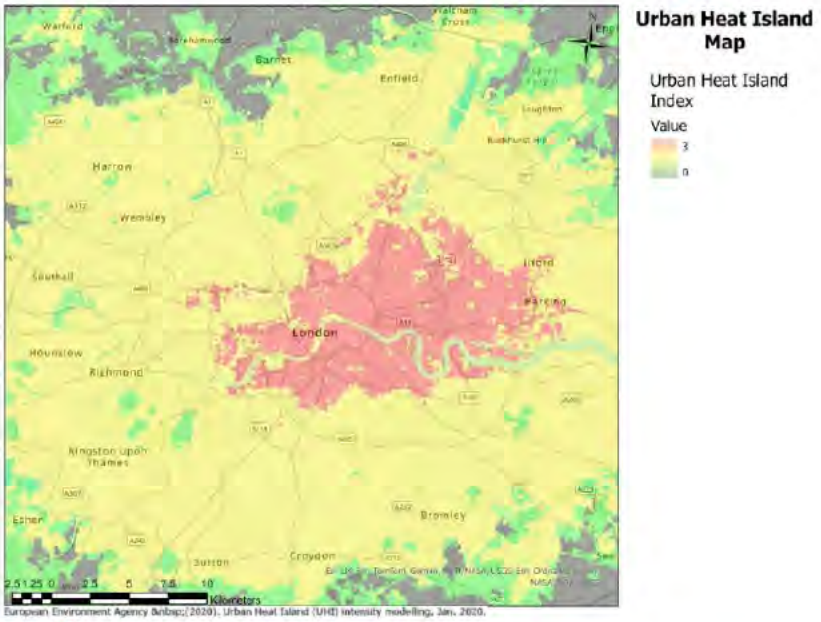

Figure 6: Urban heat island of London in degrees Celcius.

Commented [redacted]: Overlay Greater London boundary on the map for ease of interpretation

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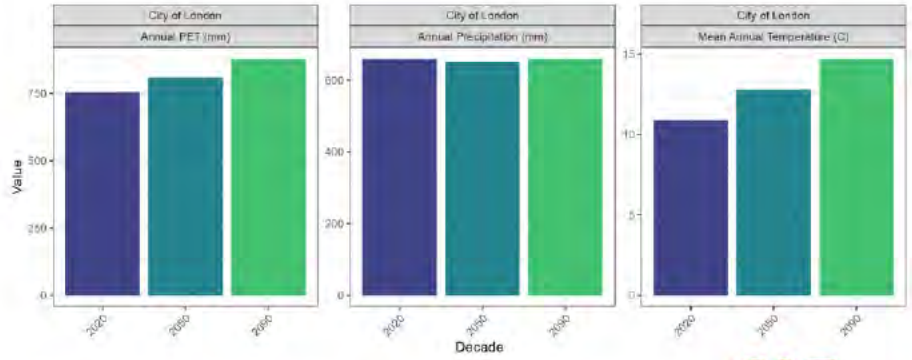

Figure 7: Key climate metrics for the City of London in response to climate scenario SSP3.

From the perspective of establishing, growing and maintaining trees, the climate in London is set to become more challenging for many species. This is mainly as a ~~function~~ result of increasing mean annual temperature as precipitation is set to remain relatively stable. Annual potential evapotranspiration rates will increase with temperature, so water deficits are likely to become more acute even in the circumstance where precipitation levels are maintained.

xxx

Commented [redacted]: Add box on SSP3 scenario in close proximity to Figure 7. The box should say something like:
The SSP3 scenario — part of the Shared Socioeconomic Pathways (SSPs) used in climate modelling — describes a future where the world experiences high challenges to both mitigation and adaptation. It assumes:
- ***Fragmented international cooperation**, with countries prioritising domestic concerns over global climate action.*
- ***Slow economic development and limited technological progress**, especially in low-income regions.*
- ***High population growth** in some areas, increasing pressure on resources.*
- ***Continued reliance on fossil fuels**, leading to high greenhouse gas emissions.*

*In the context of this report, SSP3 represents a **high-risk climate scenario**, helping to model how London's tree species might fare under more extreme future conditions.*

Commented [redacted]: Ok. 3 reviewers have commented on this sentence and recommended we try to enhance flow and clarity.

Here is what I propose - you are the tree biology expert, so please tweak as you see fit: *As temperatures rise, trees will face greater stress. Although annual rainfall is projected to remain relatively stable, higher temperatures will increase potential evapotranspiration (PET)— the amount of water lost through evaporation and plant transpiration. This means trees will need more water to survive, but less will be available, making water deficits more acute even if rainfall doesn't decline.*

Commented [redacted]: Add a paragraph here (or somewhere else!!) to explain briefly that while some impacts of climate change (e.g. increased CO2 level) will enhance the water efficiency of trees (Refer BiforFACE / Gardner work) this does not change the fact that trees will still need to access water to meet their water needs, and it is the impact of the increasingly challenging conditions trees will face for this that this report looks at. ...Maybe something like:

While elevated atmospheric CO_2 may improve water use efficiency in some tree species, this does not eliminate the risks posed by increased heat and reduced water availability — particularly in urban environments like London, where rooting conditions are often restricted. The traits assessed in this study remain relevant for understanding how trees respond to combined stresses, and the emphasis on provenance offers a practical, evidence-based approach to selecting trees with greater resilience.

Our methodological approach to species evaluation

~~Understanding the climate suitability of a species is challenging as it is likely to depend not only on the species but also on the ecotypic provenance of the tree in question.~~ Understanding the climate suitability of a tree species is complex. It depends not only on the species itself, but also on its **provenance** — that is, the geographic origin of the plant material, which can influence how well a tree copes with specific environmental conditions. Climate suitability can vary not only between different species (**interspecific variation**) but also within a single species (**intraspecific variation**) depending on its provenance. This means that even trees of the same species may respond differently to future climate conditions depending on where they were sourced from.~~Thus, there may be both intraspecific and interspecific variation in climate suitability across the trees used in London's public realm.~~ Furthermore, the quality of the data used to inform the future suitability will have a material influence on the climate suitability outcome statements associated with the species. For many species, high quality data is available, but for some species, limited data reduces the confidence of analysis.

Urban Plant Lab utilises climate modelling tools and plant trait datas to ~~infer~~ assess how suitable different tree species ~~suitability to are for~~ future climate scenarios. ~~No~~ Because no single ~~metric~~ measure ~~gives an infallible estimation of~~can perfectcly predict suitability, ~~therefore,~~ we developed a novel composite ~~score~~ scoring ~~for climate suitability~~system ~~based on~~that combines **species distribution modelling (SDM)** ~~and~~ with three key **plant traits** ~~that are instructive in~~. These traits help us understand a species' ~~relation to ecological strategy~~ – how it grows, competes and survives in its environment - ~~and~~ its **stress tolerance**[5], or ability to cope with challenges lie drought, heat, and poor soil conditions. Whilst there ~~is~~ are ~~a multiplicity of~~many techniques available ~~that could be used~~ to evaluate ~~likely~~ stress tolerance, ~~extensive~~ large-scale controlled-environment trials ~~combined with~~and common-garden experiments are not ~~viable~~ practical for hundreds of species. ~~It is.~~This is why, ~~therefore, critical~~ when screening large inventories, it is critical to ~~utilise~~ rely on existing tools and datasets ~~that already exist~~ that offer scalable and scientifically grounded insights.

Climate and Species Distribution Modelling

~~We integrated future climate modelling with plant functional trait data to assess the suitability of tree species found within London.~~
The species distribution modelling is based on analysis of global plant and climate data, this facilitates the plotting of species distributions in the context of climate.

To model future climate conditions in London, we used projections from ~~Downscaled~~ CHELSA (Climatologies at High Resolution for the Earth's Land Surface Areas) ~~projections~~[6]. CHELSA provides high-resolution climate data by downscaling global climate models – a process that refines large scale projections to better reflect local conditions, making the data particularly useful for modelling urban microclimates like London's.

[5] Sjöman, H., Hirons, A. and Martin, K.W., 2025. Species-specific evaluation of growth and environmental tolerance for ecosystem services–evaluation from a botanic tree collection. *Urban Ecosystems*, *28*(3), p.114.
[6] https://chelsa-climate.org/

Commented [redacted]: We need a box with definition of **Provenance, Ecotype, and Genotype**. All three terms are used - especially in the narrative describing the outcome statement. We really need to cast a light on what this means, in an accessible way.

So maybe something like:

Provenance refers to the geographic origin of the plant material. Trees of the same species can have different traits depending on where they were grown — for example, a silver birch from southern Spain may be more drought-tolerant than one from Scotland.
Ecotype refers to a genetically distinct population within a species that has adapted to specific environmental conditions. Ecotypes are shaped by long-term evolutionary pressures and may differ in traits like growth rate, leaf structure, or stress tolerance.
Genotype refers to the genetic makeup of an individual organism — the full set of genes it carries. While ecotypes represent populations with shared adaptations, genotypes are specific to individuals and determine their potential for traits like stress tolerance, growth rate, and disease resistance. In tree selection, understanding genotype helps identify individuals with desirable traits, while provenance and ecotype guide broader population-level choices

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When assessing how well a tree species might cope with future climate conditions, it is important to consider more than just temperature. Whilst **mean temperature of the growing season** (MTGS[7]) gives a good indication of a tree species' thermal preferences, it does not reflect how much water is available to the plant — a key factor in its landscape performance.

To provide a more comprehensive analysis, we included the Climatic Moisture Index (CMI), which reflects the balance between precipitation and evaporation. CMI helps us understand how dry a place is likely to be, both now and in the future. By using both MTGS and CMI together, we gain a clearer understanding of the climate envelope in which a species can thrive. This is especially important as climate change is expected to bring not just warmer temperatures but also changes in water availability. An example of a species distribution model can be seen for a suitable species, holm oak (*Quercus ilex*) and a vulnerable species, silver birch (*Betula pendula*) (Figure 8).

To evaluate species suitability, future CMI projections for London in the 2090s were compared against species-specific tolerance limits. These limits - defined by the 5th to 95th percentile range of observed CMI values - were derived from cleaned observation data obtained from the Global Biodiversity Information Facility (GBIF)[8] and compiled in the TreeGOER database[9] (see box). This comparison allowed us ~~provided estimates of future temperature and moisture balance (based on ratio of annual potential evapotranspiration and precipitation; see figure 7. Species-specific tolerance limits (5th to 95th percentile CMI values) from cleaned GBIF observation data[10] were compared with these projections~~ to determine whether London's future climate falls within, at the edge of, or outside a species' specific climatic niche.

[7] Growing season is defined as April to October (inclusive).
[8] https://www.gbif.org/
[9] Kindt, R. (2023) TreeGOER: A database with globally observed environmental ranges for 48,129 tree species. Global Change Biology. 29(22), pp.6303-6318.
[10] ~~https://www.gbif.org/~~

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Commented [redacted]: Add a sidebar/box on the **Global Biodiversity Information Facility (GBIF)**. This box could read as follow: "*The Global Biodiversity Information Facility (GBIF) is an international network and data infrastructure funded by governments around the world. Its mission is to provide open access to data about all types of life on Earth, supporting research, conservation, and sustainable development.*
GBIF aggregates biodiversity data from thousands of institutions globally, including species occurrence records, observations, and specimen collections. For this project, GBIF data is used to understand where different tree species naturally occur, which helps assess their climate suitability based on where they currently thrive."

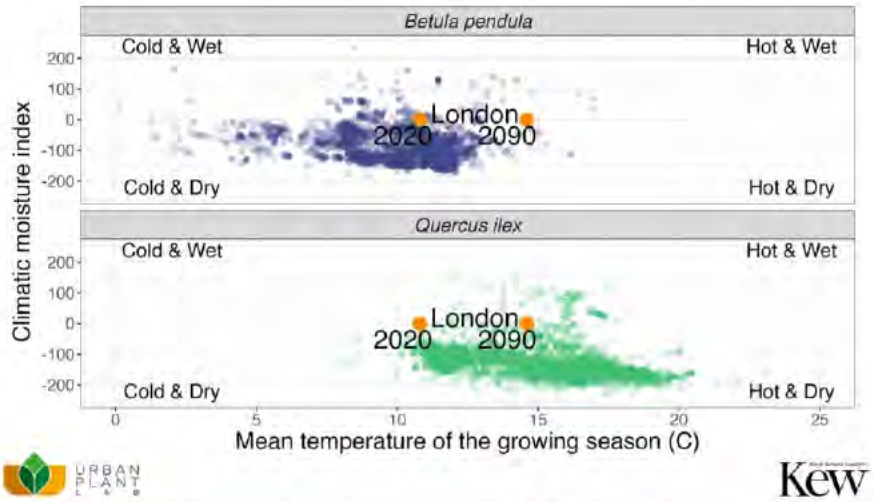

Figure 8: Example of a species distribution model for silver birch (*Betula pendula*), a 'Vulnerable' species and holm oak (*Quercus ilex*), a 'High suitability' species. Each point represents a population of the species in relation to its climate. The larger orange points represent the current and future climate of London according to SSP3. N.B.: A climate moisture index of 0 represents a climate in which the potential evapotranspiration is equal to precipitation.

~~To capture biological stress tolerance, we incorporated three key functional traits leaf dry matter content (LDMC), wood density (WD), and leaf turgor loss point (TLP) grouped into clusters representing different tendencies from highly acquisitive species characterised by fast growth and low stress tolerance to more conservative species characterised by high stress tolerance. For each species, climate suitability and trait clusters were combined into a composite score that classifies species as: 'High suitability', 'Moderate suitability', 'Low suitability' or 'Vulnerable' under late century conditions.~~

To evaluate the climatic suitability of each species, the model compares the local Climatic Moisture Index (CMI) of each city with the species-specific tolerance thresholds (Q05 and Q95) from the TreeGOER database[11]. Cities are classified into CMI Zones, Optimal, Within Range, or Outside Range, based on whether local conditions exceed, fall within, or are below the species' tolerance limits. Each city is then assigned a climate suitability score on a four-point scale, where conditions above the optimal threshold receive the highest score, intermediate values receive moderate scores, and conditions below the lower tolerance receive the lowest score. This

[11] Kindt, R. (2023) TreeGOER: A database with globally observed environmental ranges for 48,129 tree species. Global Change Biology, 29(22), pp.6303-6318.

approach allows a clear, quantitative assessment of how well London's climate aligns with the ecological preferences of different species.

Commented [redacted]: I do not understand how to integrate the information provided in this paragraph with what comes before. Up to that point, we are focusing on species and mapping species tolerances, based on observed spatial distribution - so as to inform the climate suitability score. Here we switch to a scoring cities. Also this speaks about "the model"… but this model comes after a lot of talk of other models (CHELSA, etc) so, you might need to say: "we built a model to undertake the comparisons described above". And explain of the city scoring then translates into the species suitability score derived from SDM that is part of your composite score.

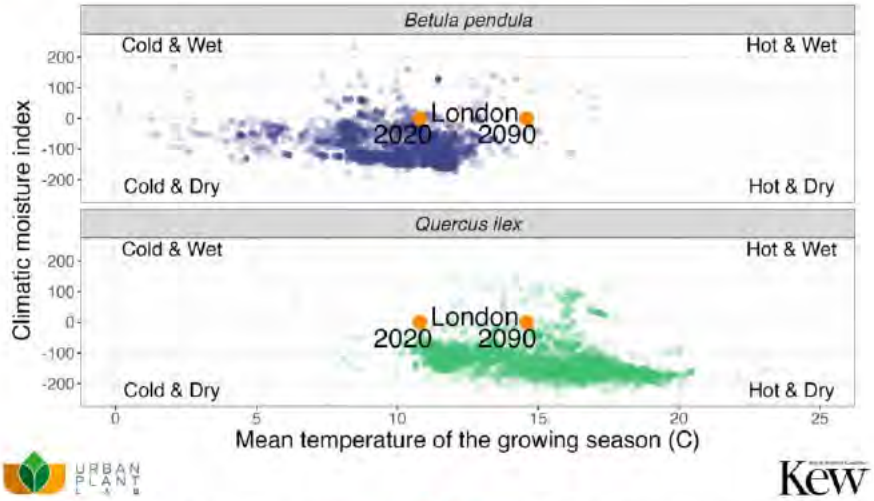

Figure 8: Example of a species distribution model for silver birch (*Betula pendula*), a 'Vulnerable' species and holm oak (*Quercus ilex*), a 'High suitability' species. Each point represents a population of the species in relation to its climate. The larger orange points represent the current and future climate of London according to SSP3. N.B.: A climate moisture index of 0 represents a climate in which the potential evapotranspiration is equal to precipitation.

Plant trait analysis

To assess the ~~b~~biological stress tolerance of London's public realm trees, we focused on three key functional traits: **leaf dry matter content (LDMC), wood density (WD), and leaf turgor loss point (TLP) — all recognised indicators of a tree's ability to withstand drought stress.**

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~~Plant~~ Functional plant traits are measurable characteristics that ~~are known to assist in the inference of~~help infer a species' (or ~~genotype~~provenance's) ecological strategy ~~in -- relation to~~ how it grows~~th~~, reproduce~~stive capacity or~~ and copes with environmental stress ~~tolerance~~. To support this analysis, g~~G~~lobal ~~plant~~ trait data from the ~~(~~TRY Database)[12] was~~ere~~ combined with data ~~collected~~ from our own research ~~group~~ and other published ~~literature~~sources.

[12] Kattge, J., Bönisch, G., Díaz, S., Lavorel, S., Prentice, I.C., Leadley, P., Tautenhahn, S., Werner, G.D., Aakala, T., Abedi, M. and Acosta, A.T. (2020) TRY plant trait database–enhanced coverage and open access. *Global change biology*, *26*(1), pp.119-188.

These ~~chosen~~ traits were ~~then clustered into~~grouped into four ~~groups~~ categories using a k-means clustering algorithm[13] (see box)~~–~~, representing a spectrum from highly acquisitive species — which grow quickly but are less tolerant to stress — to more conservative species, which grow more slowly but are better adapted to withstand environmental challenges. Each species was assigned a trait score from one to four based on its cluster. ~~to provide an individual trait score of one to four~~. This statistical approach ensures that scoring is based on global datasets rather than subjective thresholds. For example, global wood density values were clustered to produce Figure 9. ~~In this way, we allocate the trait score using statistical methodology that is informed by global datasets rather than making subjective decisions on the threshold values between scores.~~ For example, global wood density values were ~~are~~ evaluated and clustered to ~~give~~ produce figure 9, ~~these cluster~~from which scores were ~~then~~ extracted for ~~the~~ each species evaluated. Further details on each trait are provided below. ~~The three traits included in this analysis were:~~

Wood Density (WD)

Wood density (measured in grams per cubic centimetre~~m~~^{3}) ~~integrates a number~~reflects several ~~of~~ aspects of a tree's ecological strategy. Species with ~~higher density~~ denser wood ~~are found~~tend to grow in more stressful ~~sites~~ environments ~~that~~ and ~~require greater~~ invest~~ment~~ more in structural strength ~~stress resilience~~ and defence, making them better equipped to withstand drought and other stressors. ~~whereas~~ In contrast, ~~those species~~ with less dense wood are typically more competitive ~~in~~en fertile ~~sites~~conditions, but less resilient to environmental stress[14]. Globally, ~~T~~temperature has been ~~found to be~~identified as a major~~, global~~ driver ~~for~~ of variation in wood density ~~variation~~[15], ~~thus it is instructive when~~making this trait particularly useful when evaluating how trees ~~stress resilience~~may respond to future climate scenarios.

Commented [ ]: Have a little bow or sidebar that explains **K-means clustering**. This box could say something like this: *K-means clustering is a statistical method used to group items — in this case, tree species — into categories based on how similar they are across selected traits. It helps identify patterns in large datasets by organising species into clusters that share similar characteristics, such as how they respond to drought or grow in different environments.*

[13] Hartigan, J.A. and Wong, M.A., 1979. Algorithm AS 136: A k-means clustering algorithm. *Journal of the royal statistical society. series c (applied statistics)*, *28*(1), pp.100-108.
[14] Chave, J., Coomes, D., Jansen, S., Lewis, S.L., Swenson, N.G. and Zanne, A.E. (2009) Towards a worldwide wood economics spectrum. *Ecology letters*, *12*(4), pp.351-366.
[15] Mo, L., Crowther, T.W., Maynard, D.S., Van den Hoogen, J., Ma, H., Bialic-Murphy, L., Liang, J., De-Miguel, S., Nabuurs, G.J., Reich, P.B. and Phillips, O.L., 2024. The global distribution and drivers of wood density and their impact on forest carbon stocks. *Nature Ecology & Evolution*, pp.1-18.

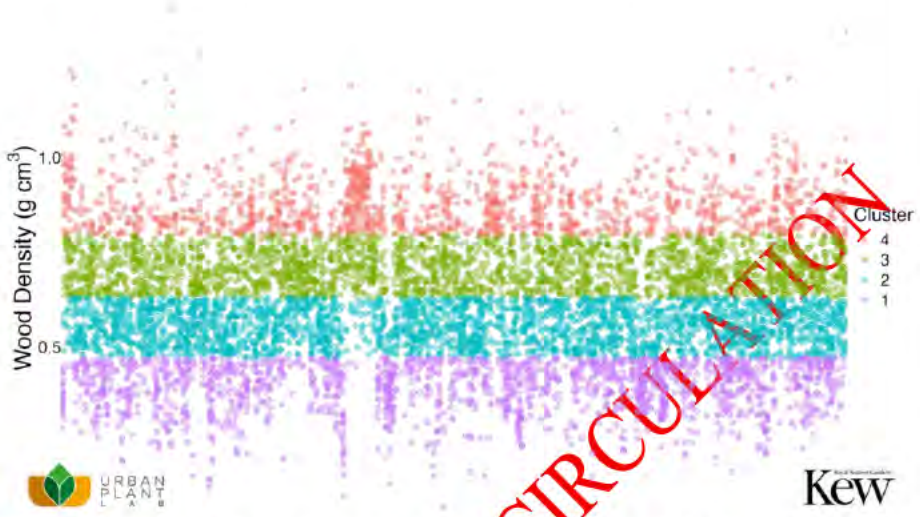

Figure 9: Example of the way in which cluster analysis was used to derive a four-point score and used to contribute to the overall climate suitability score. In the case of the wood density trait: 4 was awarded for a density above 0.78 (g/cm³); 3 was awarded for between 0.61 – 0.78; 2 was awarded between 0.46 and 0.61; and, a score of 1 for <0.46. Cluster levels were determined using the k-means method. A similar analysis was used for the other plant trait data (LDMC, TLP: (plots not shown)).

Leaf Dry Matter Content (LDMC)

LDMC (measured in milligrams per gram) is a key indicator of a tree's resilience to environmental stress. ~~Research has shown~~[16] shows that ~~LDMC (mg g^{-1}) is related to stress resilience: species with a~~ low LDMC ~~are more~~tend to be more vulnerable to heat and drought ~~than~~ while those with ~~a~~ higher LDMC. ~~Higher LDMC are better equipped to cope with water scarcity. A higher LDMC~~ reflects a greater investment in robust leaf tissue, ~~which helps trees maintain function during dry periods. robustness that is necessary to cope with periods of water deficit and represents a more~~ and is characteristics of a more conservative ecological strategy – one focused on survival rather than rapid growth.

Turgor Loss Point (TLP)

TLP (measured in megapascals, MPa) refers to the leaf water potential at which turgor pressure is lost. TLP ~~The leaf water potential at turgor loss (-MPa)~~ directly quantifies leaf and plant drought tolerance. The more negative the TLP value, the longer a tree can maintain key physiological functions, such as water transport (hydraulic conductance) and gas exchange (stomatal conductance) during ~~can be maintained under soil~~ dry conditionsing[17]. It is widely used in ecological ~~studies and in~~ research

[16] Petruzzellis, F., Tordoni, E., Di Bonaventura, A., Tomasella, M., Natale, S., Panepinto, F., Bacaro, G. and Nardini, A. (2021) Turgor loss point and vulnerability to xylem embolism predict species-specific risk of drought-induced decline of urban trees. *Plant Biology*, *24*(7), pp.1198-1207.

[17] Bartlett, M.K., Scoffoni, C. and Sack, L. (2012) The determinants of leaf turgor loss point and prediction of drought tolerance of species and biomes: a global meta-analysis. *Ecology letters*, *15*(5), pp.393-405.

and increasingly applied to guide ~~used to inform~~ tree selection for urban environments[18], where drought stress is a growing conern.

Determination of Outcome Statements

To evaluate future climate suitability, each species was assigned a composite score, calculated as the average of its individual scores from species distribution modelling (SDM), wood density (WD), leaf dry matter content (LDMC), and turgor loss point (TLP). The resulting score ranges from one to four.

~~The species' scores for the SDM, WD, LDMC and TLP was averaged (mean) to give a composite score: the lowest possible score is one and the highest possible score is four.~~ Species scoring

- ~~between one~~ 1.0 to ~~two~~ 2.0 were evaluated as being 'Vulnerable'.
- 2.0 to 3.0 were classified as 'Low Suitability' ~~Those species that scored between two and three that were noted to have~~if their current species distribution falls ~~were evaluated as having~~ 'outside of range' for the future climate projection, and ~~were evaluated as having 'Low suitability' whilst those that were found to be 'within range' were evaluated as having~~ 'Moderate suitability' if their distribution was found to be within range.
- 3.0-4.0 were classified as ~~Only those species with a composite score of between three and four were evaluated as having~~ 'High suitability', indicating strong evidence of climate compatibility. ~~The high suitability species will also have had evidence that~~ (their current distribution is within range of London's future climate) and ~~had trait evidence suggesting~~ high stress tolerance (Table 1).

Whilst ~~the~~ high-quality ~~of the~~ data was ~~high~~ available for many species, ~~it is important to acknowledge that a data deficit was apparent in some cases. For example, there may not be data for all the desired traits available~~some had gaps in traits data. In such cases, ~~a trait cluster score was assigned~~scores were estimated using data from closely related species for which data was available and expert judgement. To enhance transparency of the analysis a confidence score ~~has been allocated~~was assigned to each outcome statement (Table 2). Low confidence was ~~allocated~~ given to species ~~that have had scores~~with estimated scores for two or more ~~of the~~ criteria ~~being evaluated, whilst h~~. High confidence was ~~allocated~~ assigned to species that have a maximum of one estimated trait ~~cluster~~score. ~~In addition to improving the transparency of the analysis, this~~This confidence scoring also provides a gap ~~-~~analysis to help focus future research efforts.

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[18] Hirons, A.D., Watkins, J.H.R., Baxter, T.J., Miesbauer, J.W., Male-Muñoz, A., Martin, K.W., Bassuk, N.L. and Sjöman, H. (2021) Using botanic gardens and arboreta to help identify urban trees for the future. *Plants, People, Planet*, *3*(2), pp.182-193.

Table 1: Explanation of outcome statements.

Outcome statements	Narrative description of outcome
High suitability	This species is well suited to ~~the~~ current climate norms and its ~~current~~ natural distribution substantially overlaps with the future climate analogue. Trait datas indicates excellent tolerance to climate-related stress. These species are likely to ~~have high suitability to~~perform well under future ~~climate~~conditions. Selecting appropriate p~~P~~rovenance and ecotypes ~~selection is likely to optimise~~ can further optimise future climate compatibility.
Moderate suitability	This species is suited to ~~the~~ current climate norms and its current distribution overlaps with the future climate analogue at its margin. Trait datas indicates good tolerance to climate-related stress. Therefore, these species are likely to have moderate suitability to future climate. With ~~focused effort,~~ targeted selection of provenance and ecotypes ~~, and provenance selection is likely to yield~~ it may be possible to identify plant material that will have high suitability for future climate scenarios.
Low suitability	These species are suited to the today's climate, but only a very minor percentage of the species' current distribution occurs in regions within a future climate analogue. Traits indicate some vulnerability to climate-related stress. Therefore, these species are likely to have a low suitability to future climate. With focused effort, targeted ecotypic and provenance selection may yield suitable plant material for successful cultivars. Examples of these species currently in the landscape may require more intensive management to mitigate abiotic stress and maintain tree performance.
Vulnerable	These species are suited to today's climate, but their current distribution does not occur in regions within a future climate analogue. Trait datas indicates vulnerability to climate-related stress. ~~Therefore, these species are likely to have vulnerability to future climate scenarios; targeted~~ Suitable plant material is unlikely to be identified through provenance and ecotype ~~and provenance~~ selection, ~~is not likely to yield suitable plant material for successful cultivars. Examples of these species currently in the landscape~~Existing trees may require more intensive management to mitigate abiotic stress and maintain tree performance.

Commented [redacted]: One reviewer suggested coupling these outcome statements with some form of icon - that could be used throughout (e.g. fig 10, table 2…). I have copied his suggestion in fig 10 just as a starting point for you and [redacted] to potentially explore the idea.

Climate suitability of London's Public Realm Trees - Results

To deliver a comprehensive evaluation of London's public realm trees, we selected the top 100 species ~~from~~ identified in the taxonomic review and ~~evaluated them for their~~ assessed their suitability to a future climate scenario (SSP3). ~~In concert~~Together, these species ~~comprised of~~account for 95% of London's public realm trees – making this a robust and representative analysis~~. Therefore, this analysis represents a comprehensive evaluation of the London's public realm trees.~~ Only ~~very~~ a small number of minor species - representing less than 0.12 % - ~~have not been subject to analysis.~~ were not included in the assessment.

Xxx

London is assessed to ~~only~~ have only two species, holm oak (*Quercus ilex*) and Persian ironwood (*Parrotia* persica) ~~or 0.38% or the public realm trees~~ that ~~is considered to have~~ fall within the 'high suitability' category, representing just 0.38% of the public realm tree population (figure 11). ~~This~~ These ~~is a~~ species are native to the Mediterranean basin and western Asia. A further 22.05% of trees ~~the public realm trees have been~~ are assessed ~~to~~ as having 'moderate suitability'. ~~The most important trees of 'moderate suitability'~~Notable species in this category are London plane (*Plantanus* x *hispanica*) and hawthorn (*Crataegus monogyna*).

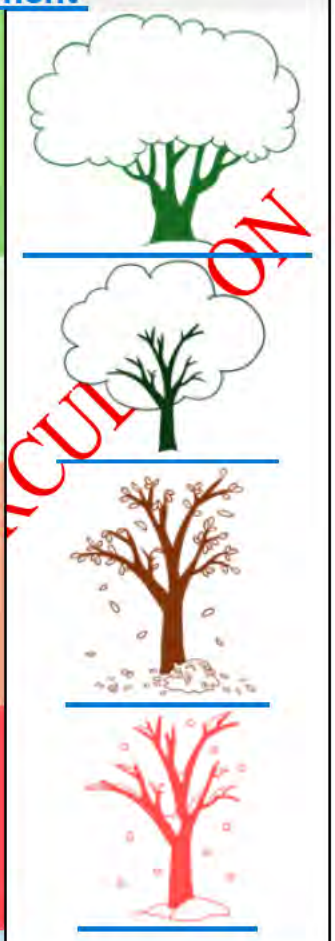
Tree with 'Low suitability' ~~trees~~ make up 62.35% of London's public realm trees. ~~,~~ T~~t~~his category includes pedunculate oak (*Quercus robur*), Norway maple (*Acer platanoides*) and sycamore (*Acer pseudoplatanus*). Unfortunately, 10.64% of ~~the public realm~~ trees were found to be 'vulnerable' to the projected conditions ~~at~~ by the end of this century. This ~~category~~ group includes ash (*Fraxinus excelsior*), *wild cherry* (*Prunus avium*) silver birch (*Betula pendula*) and large-leaved lime (*Tilia platyphyllos*). Further details ~~of the~~on species ~~found~~ within each category ~~can be found~~ are provided in T~~t~~able 2.

It is striking that such a high percentage (73%) of trees ~~are found within~~fall into the lower two suitability categories. Climate risk to trees is further compounded by poor growing environments. ~~Therefore~~Together, th~~ese factors~~ese present~~s~~ a substantial and strategic challenge for urban forest managers to ~~mitigate~~ address over the coming decades.

Commented [redacted]: Highlight here clearly that the finding from this work, presented below are applicable on to London and its microclimate. Inference should not be made about tree suitability for other UK cities.

Commented [redacted]: In the comms around this report, we have moved from a place where we initially primarily honed on the threats - to a message where we frame this work as a *call to action*, which is what you highlight here. 65 years is not a lot of time (in tree terms) to mitigate the challenge identified, but there is scope to act (especially given the average lifespan of most urban trees). This report equips tree managers across London with the evidence needed to make smarter choices in what to plant, how to plant… Is that something you would feel comfortable emphasising more? The levels of suitability highlighted are very real if all things remain equal. But they do not equate forecast of doom - because these findings are identified within a timeframe that do allow some change to happen. There is a window of opportunity to seize!!!

Percentage Suitability	Outcome statement
0.38%	High suitability
22.05%	Moderate suitability
62.35%	Low suitability
10.64%	Vulnerable
4.62%	Not evaluated



Percentage Suitability	Outcome statement
0.38%	High suitability
22.05%	Moderate suitability

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62.35%	Low suitability
10.64%	Vulnerable
4.62%	Not evaluated

Figure 10: Summary of the percentage of trees in each suitability class for the London contex. [Alternative infographic could be developed, but I think it is useful to have headlines presented in a clear format]

Commented [redacted] Agreed.

Tables 2 and 3 provide a more detailed breakdown of the species evaluation, together with a confidence score in the outcome statement.

Table 2 (option 1): Outcome summaries, with confidence statements for the 100 focus species of this study. Species were given a low confidence score when the cluster score for a trait had to be estimated, rather than based on data from the scientific literature.

Outcome Statement	Confidence Score	Species (TaxonName)
High suitability	High	*Quercus ilex*
	Low	*Parrotia persica*
Moderate suitability	High	*Acer negundo, Betula utilis, Crataegus monogyna, Juglans regia, Platanus x hispanica, Prunus cerasifera, Robinia pseudoacacia, Taxus baccata*
	Low	*Acer cappadocicum, Ailanthus altissima, Betula albosinensis, Betula jacquemontii, Betula papyrifera, Catalpa bignonioides, Celtis australis Chamaecyparis lawsoniana, Corylus colurna Crataegus x lavallei, Crataegus x persimilis, Cupressus, Fraxinus angustifolia, Fraxinus ornus Ginkgo biloba, Gleditsia triacanthos, Koelreuteria paniculata, Ligustrum, Ligustrum lucidum, Pinus nigra, Pyrus calleryana, Pyrus communis, Ulmus, X Cuprocyparis leylandii*
Low suitability	High	*Acer campestre, Acer platanoides, Acer pseudoplatanus, Acer saccharinum, Aesculus hippocastanum, Alnus glutinosa, Betula pendula, Carpinus betulus, Castanea sativa, Fagus sylvatica, Ilex aquifolium, Pinus sylvestris, Populus tremula, Quercus cerris, Quercus robur, Quercus rubra, Salix alba, Salix caprea, Sorbus aucuparia, Tilia cordata,*
	Low	*Alnus cordata, Amelanchier lamarckii, Crataegus laevigata, Liquidambar styraciflua, Malus pumila, Malus sylvestris, Malus x purpurea, Metasequoia glyptostroboides, Prunus domestica, Prunus laurocerasus, Prunus padus, Prunus serrulata, Prunus spinosa, Prunus x fruticans, Salix x fragilis, Sorbus, Sorbus aria, Sorbus intermedia, Sorbus x thuringiaca, Thuja plicata, Tilia x euchlora, Tilia x europaea, Ulmus procera*
Vulnerable	High	*Alnus incana, Betula pubescens, Fraxinus excelsior, Populus nigra, Prunus avium, Tilia platyphyllos*
	Low	*Aesculus x carnea, Liriodendron tulipifera, Magnolia, Populus alba, Salix babylonica,*

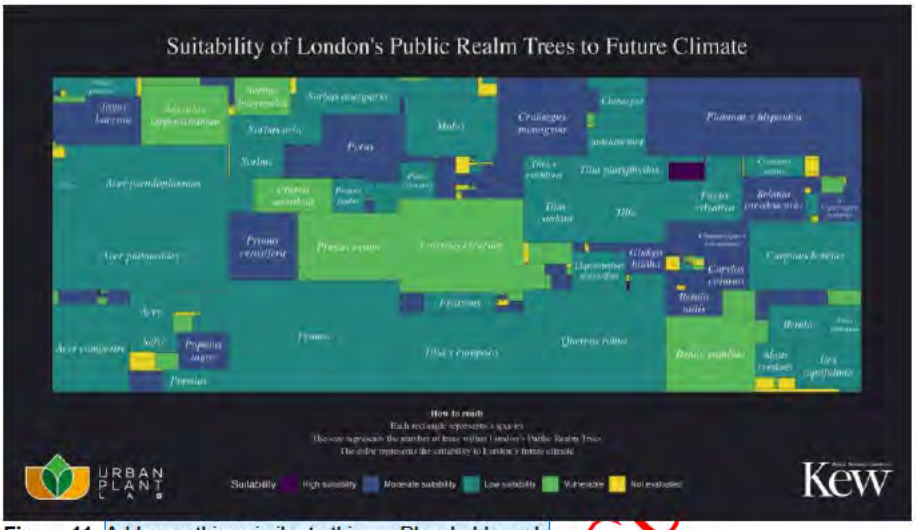

Figure 11: Add something similar to this… - Placeholder only

Commented [redacted]: Everyone liked this a lot. Colour scheme is problematic (hard to read). Once working with [redacted] consistency of use of colour when communicating about the suitability categories will be important. Also, as for other block diagrams: this warrants more space / display at a larger scale.

Table 3: Outcome summaries, with confidence statements for the 100 focus species of this study. Species were given a low confidence score when two or more cluster scores for a trait had to be estimated, rather than based on data from the scientific literature. Ranked from highest to lowest count.

Family	Genus | Species	Outcome statement	Confidence	Count	Percentage
Rosaceae	*Prunus*	Low suitability	Low	87837	7.52
Platanaceae	*Platanus x hispanica*	Moderate suitability	High	77569	6.64
Fagaceae	*Quercus robur*	Low suitability	High	66892	5.73
Sapindaceae	*Acer platanoides*	Low suitability	High	55775	4.77
Oleaceae	*Fraxinus excelsior*	Vulnerable	High	53362	4.57
Sapindaceae	*Acer pseudoplatanus*	Low suitability	High	52510	4.49
Malvaceae	*Tilia x europaea*	Low suitability	Low	45204	3.87
Betulaceae	*Carpinus betulus*	Low suitability	High	35029	3
Rosaceae	*Prunus avium*	Vulnerable	High	31803	2.72
Betulaceae	*Betula pendula*	Low suitability	High	31530	2.7
Sapindaceae	*Acer campestre*	Low suitability	High	31019	2.65
Rosaceae	*Crataegus monogyna*	Moderate suitability	High	27542	2.36
Rosaceae	*Malus*	Low suitability	Low	25652	2.2
Sapindaceae	*Aesculus hippocastanum*	Low suitability	High	23652	2.02
Rosaceae	*Pyrus*	Moderate suitability	Low	22769	1.95
Malvaceae	*Tilia*	Low suitability	Low	21562	1.85
Rosaceae	*Prunus cerasifera*	Moderate suitability	High	21472	1.84
Rosaceae	*Sorbus aucuparia*	Low suitability	High	17829	1.53
Malvaceae	*Tilia cordata*	Low suitability	High	17314	1.48
Aquifoliaceae	*Ilex aquifolium*	Low suitability	High	13706	1.17
Fabaceae	*Robinia pseudoacacia*	Moderate suitability	High	13208	1.13
Rosaceae	*Sorbus aria*	Low suitability	Low	12600	1.08
Rosaceae	*Prunus serrulata*	Low suitability	Low	12436	1.06
Malvaceae	*Tilia platyphyllos*	Vulnerable	High	11252	0.96

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Betulaceae	*Betula*	Low suitability	Low	10566	0.9
Fagaceae	*Fagus sylvatica*	Low suitability	High	10478	0.9
Rosaceae	*Sorbus intermedia*	Low suitability	Low	9788	0.84
Hamamelidaceae	*Liquidambar styraciflua*	Low suitability	Low	9562	0.82
Taxaceae	*Taxus baccata*	Moderate suitability	High	8982	0.77
Salicaceae	*Populus nigra*	Vulnerable	High	8481	0.73
Rosaceae	*Sorbus*	Low suitability	Low	8473	0.73
Sapindaceae	*Acer*	Low suitability	Low	8417	0.72
Cupressaceae	*Chamaecyparis lawsoniana*	Moderate suitability	Low	8314	0.71
Rosaceae	*Amelanchier*	Low suitability	Low	7855	0.67
Betulaceae	*Betula utilis*	Moderate suitability	High	6920	0.59
Oleaceae	*Fraxinus*	Low suitability	Low	6544	0.56
Sapindaceae	*Acer saccharinum*	Low suitability	High	6275	0.54
Betulaceae	*Alnus cordata*	Low suitability	Low	6183	0.53
Betulaceae	*Corylus colurna*	Moderate suitability	Low	6022	0.52
Ulmaceae	*Ulmus procera*	Low suitability	Low	5951	0.51
Betulaceae	*Alnus glutinosa*	Low suitability	High	5945	0.51
Pinaceae	*Pinus sylvestris*	Low suitability	High	5892	0.5
Cupressaceae	*X Cuprocyparis leylandii*	Moderate suitability	Low	5777	0.49
Fagaceae	*Castanea sativa*	Low suitability	High	5710	0.49
Ginkgoaceae	*Ginkgo biloba*	Moderate suitability	Low	5524	0.47
Salicaceae	*Populus*	Low suitability	Low	5396	0.46
Rosaceae	*Crataegus*	Low suitability	Low	5195	0.44
Malvaceae	*Tilia x euchlora*	Low suitability	Low	5036	0.43
Rosaceae	*Prunus padus*	Low suitability	Low	4936	0.42
Salicaceae	*Salix*	Low suitability	Low	4499	0.39
Ulmaceae	*Ulmus*	Moderate suitability	Low	4332	0.37

Magnoliaceae	*Magnolia*	Vulnerable	Low	4276	0.37
Fagaceae	*Quercus*	Low suitability	Low	4181	0.36
Fabaceae	*Gleditsia triacanthos*	Moderate suitability	Low	4073	0.35
Betulaceae	*Betula pubescens*	Vulnerable	High	3984	0.34
Cupressaceae	*Cupressus*	Moderate suitability	Low	3809	0.33
Simaroubaceae	*Ailanthus altissima*	Moderate suitability	Low	3795	0.32
Fagaceae	*Quercus cerris*	Low suitability	High	3725	0.32
Pinaceae	*Pinus nigra*	Moderate suitability	Low	3553	0.3
Rosaceae	*Amelanchier lamarckii*	Low suitability	Low	3286	0.28
Rosaceae	*Crataegus laevigata*	Low suitability	Low	3163	0.27
Salicaceae	*Salix caprea*	Low suitability	High	3030	0.26
Rosaceae	*Crataegus x persimilis*	Moderate suitability	Low	3007	0.26
Fagaceae	*Quercus ilex*	High suitability	High	2953	0.25
Rosaceae	*Pyrus communis*	Moderate suitability	Low	2790	0.24
Salicaceae	*Salix x fragilis*	Low suitability	Low	2773	0.24
Salicaceae	*Salix alba*	Low suitability	High	2768	0.24
Rosaceae	*Pyrus calleryana*	Moderate suitability	Low	2701	0.23
Salicaceae	*Populus alba*	Vulnerable	Low	2599	0.22
Fagaceae	*Quercus rubra*	Low suitability	High	2580	0.22
Betulaceae	*Betula jacquemontii*	Moderate suitability	Low	2550	0.22
Magnoliaceae	*Liriodendron tulipifera*	Vulnerable	Low	2529	0.22
Oleaceae	*Fraxinus ornus*	Moderate suitability	Low	2461	0.21
Sapindaceae	*Acer negundo*	Moderate suitability	High	2433	0.21
Rosaceae	*Malus sylvestris*	Low suitability	Low	2346	0.2
Betulaceae	*Alnus incana*	Vulnerable	High	2270	0.19
Sapindaceae	*Aesculus x carnea*	Vulnerable	Low	2194	0.19
Rosaceae	*Prunus x fruticans*	Low suitability	Low	2157	0.18

Oleaceae	*Ligustrum*	Moderate suitability	Low	2042	0.17
Rosaceae	*Malus pumila*	Low suitability	Low	1930	0.17
Rosaceae	*Prunus laurocerasus*	Low suitability	Low	1912	0.16
Rosaceae	*Crataegus x lavallei*	Moderate suitability	Low	1874	0.16
Oleaceae	*Fraxinus angustifolia*	Moderate suitability	Low	1859	0.16
Rosaceae	*Prunus spinosa*	Low suitability	Low	1856	0.16
Betulaceae	*Betula papyrifera*	Moderate suitability	Low	1760	0.15
Salicaceae	*Populus tremula*	Low suitability	High	1756	0.15
Rosaceae	*Malus x purpurea*	Low suitability	Low	1672	0.14
Bignoniaceae	*Catalpa bignonioides*	Moderate suitability	Low	1648	0.14
Sapindaceae	*Koelreuteria paniculata*	Moderate suitability	Low	1633	0.14
Rosaceae	*Prunus domestica*	Low suitability	Low	1622	0.14
Betulaceae	*Betula albosinensis*	Moderate suitability	Low	1595	0.14
Cupressaceae	*Thuja plicata*	Low suitability	Low	1546	0.13
Hamamelidaceae	*Parrotia persica*	High suitability	Low	1528	0.13
Salicaceae	*Salix babylonica*	Vulnerable	Low	1513	0.13
Rosaceae	*Sorbus x thuringiaca*	Low suitability	Low	1473	0.13
Cupressaceae	*Metasequoia glyptostroboides*	Low suitability	Low	1429	0.12
Juglandaceae	*Juglans regia*	Moderate suitability	High	1424	0.12
Sapindaceae	*Acer cappadocicum*	Moderate suitability	Low	1411	0.12
Cannabaceae	*Celtis australis*	Moderate suitability	Low	1411	0.12
Oleaceae	*Ligustrum lucidum*	Moderate suitability	Low	1359	0.12

Candidate species for future planting

Analysis of tree suitability to London's future climate suggests that, from the pool of species already growing in London, approximately ~100 species have high or moderate suitability (Table 4). Because Tthese species, by nature of the fact that they are already found present within London, they are generally available through UK nurseries. Increasing the proportion of these speciestheir representation in future planting schemes will help enhance the overall climate suitability of the London's urban forest to conditions expected at by the end of the century.

As tree nurseries continue to tailor their species portfolio to reflect themeet growing demand for 'climate resistant' trees, the palette of trees found listed in Ttable 4 is likely to expand further.

It should be notedis worth noting that Table 4 includes that a diverse range of species is found within table 4. Choices Decisions around about which species are most appropriate their relative merit for specific planting sites within the public realm should go through acceptedfollow established tree selection decision-making protocols. This topic is discussed more fully in *Tree Selection for Green Infrastructure: A guide for specifiers*[19]. Species profiles for the species representedthose listed in Ttable 4 can beare found in Appendix 2.

Table 4: Species evaluated as high and moderate suitability which should play a role in the strategic diversification of London's urban forest. Native species in **bold**.

Outcome Statement	Species
High suitability	*Acer monspessulanum, Acer tataricum, Arbutus unedo, Cupressus arizonica, Cupressus macrocarpa, Eucommia ulmoides, Olea europaea, Ostrya carpinifolia, Parrotia persica, Quercus frainetto, Quercus ilex, Quercus suber,* ***Sorbus torminalis****, Tamarix ramosissima*
Moderate suitability	*Abies concolor, Acacia dealbata, Acer buergerianum, Acer cappadocicum, Acer davidii, Acer griseum, Acer negundo, Aesculus indica, Aesculus pavia, Amelanchier alnifolia, Betula albosinensis, Betula jacquemontii, Betula papyrifera, Betula utilis, Buxus sempervirens, Carya illinoinensis, Catalpa bignonioides, Catalpa speciosa, Cedrus atlantica, Cedrus deodara, Cedrus libani, Celtis australis, Celtis occidentalis, Cercis siliquastrum, Chamaecyparis lawsoniana, Corylus colurna, Corylus maxima, Crataegus x lavallei,* ***Crataegus monogyna****, Crataegus x persimilis, Cupressus sempervirens, Cydonia oblonga, Diospyros kaki, Elaeagnus angustifolia, Eucalyptus pauciflora, Fagus orientalis, Ficus carica, Ginkgo biloba, Gleditsia triacanthos, Gymnocladus dioica, Heptacodium miconioides, Hippophae salicifolia, Juglans nigra, Juglans regia, Juniperus scopulorum, Juniperus virginiana, Koelreuteria paniculata, Ligustrum japonicum, Ligustrum lucidum, Malus baccata, Malus yunnanensis, Morus alba, Morus nigra, Nothofagus antarctica, Paulownia*

Commented [redacted]: Yes please go ahead with this.

Commented [redacted]: [redacted] would you like this in a different format? What do you think about the idea of including an appendix with the TDAG species profiles to aid interpretation.

Commented [redacted] This is a useful approach. The idea of a separate table focusing on native is also worth adding.

[19] Available at: [add link]

	tomentosa, Picea pungens, Pinus contorta, Pinus nigra, Pinus pinaster, Pinus pinea, Pinus radiata, Pinus wallichiana, Platanus x hispanica, Platanus orientalis, Pseudotsuga menziesii, Prunus cerasifera, Prunus dulcis, Prunus maackii, Prunus serrula, Pyrus calleryana, Pyrus communis, Quercus castaneifolia, Robinia pseudoacacia, Sequoia sempervirens, Sequoiadendron giganteum, Sorbus discolor, Sorbus vilmorinii, Styphnolobium japonicum, Syringa vulgaris, Syringa reticulata, Tamarix gallica, Tamarix tetrandra, Taxodium distichum, ***Taxus baccata,*** *Tilia mongolica, Ulmus* (resistant cultivars), X *Cuprocyparis leylandii*

Possibly add New York figure as well? This is a very precise match for London's future late century climate so there is good evidence that these species will have good compatibility.

Commented [redacted]: Yes, please. With a paragraph of text explaining this (e.g. the fact that, in respect to the key climate variable this research relied on, New York today offers a really good match to what London is likely to be like by the end of the century, therefore New York's tree palette is a useful reference) We would need some form of caveat around native species, though, as something important to also maintain 'into the mix' (something to keep the likes of Woodland Trust onside).

It would be good to weave into the report at the appropriate point (perhaps here?... And reiterated in the recommendations?) some statements such as:

"This report does not advocate indiscriminate importation of plant material. It supports a strategic, evidence-based approach to provenance selection, including sourcing from within the UK where suitable genotypes exist."

"The emphasis on climate resilience **complements** conservation goals, including maintaining native biodiversity and reducing biosecurity risks."

Recommendations

Public realm trees in London, along with the manifold benefits bestowed on communities, are threatened by a changing climate. This report makes clear that most (estimated at 72%) of the public realm trees will not be suitable for conditions expected at the end of this century. This suggests that these trees are likely to have reduced performance (growth and other ecosystem services) as a function of climate change: mortality rates within these species are also likely to increase. To mitigate the impact of this, we make the following recommendations:

1. ~~*Proactively promote*~~*Strenghten the health of existing trees*

Healthy trees are more resilient to stress. Tree performance will be enhanced when trees are growing in good-quality rooting environments characterised by sufficient soil volume and biologically healthy soils. Given an equivalence in climate, trees in healthy growing conditions experience stress more gradually and less acutely than trees growing in poor-quality conditions. There is long-term value in proactively enhancing tree growing environments, especially of large trees that contribute the greatest benefits to society. Enhancing rooting environments through soil decompaction and amelioration is a critical strategy to mitigate against climate-related stress in trees.

Recommended actions:

- Prioritise investment in rooting environments — providing for adequate soil volume and structure.
- Implement soil decompaction and improvement programmes for large, mature trees that deliver the greatest benefits.
- Promote/recognise tree health enhancement as a critical climate-adaptation action, not a maintenance activity.

Commented [redacted]: from Kew, recommended adding those bullets to each headline recommendation and its supporting narrative. I like this idea a lot, and think the points [redacted] has drafted are very good (feel free to add some or modify as you see fit)

2. *Strategically diversify London's urban forest.*

Given the variation in species suitability, tree species diversity targets measured by taxonomic metrics may lead to increased taxonomic diversity without improving the resilience to future climate. Therefore, new tree planting should focus on species that are likely to be more suitable to London's future climate. Tree selection decisions must also be cognisant of biotic threats from emerging pests and pathogens. Future research should combine this climate suitability analysis with biotic plant health risks to produce a composite risk assessment of London's trees and provide guidance on planting palettes that are suitable for future climates and have low risk from biotic threats.

Recommended actions:

- Focus new planting on species predicted to tolerate London's future climate and increasing taxonomic diversity.
- Integrate pest and disease risk assessments with climate-suitability data to guide resilient species palettes.

- Embed these criteria into borough tree strategies, procurement frameworks, and design guidance.

3. *Fund tree establishment, not tree planting*

Funding instruments designed to increase canopy cover should fund tree establishment, not tree planting. Whilst contracts and grants are awarded for tree planting, rather than the outcome of tree establishment, tree planting initiatives are likely to be compromised by low success rates. Current funding instruments need to be evaluated to ensure that species suitability is fully considered, tree planting aftercare is sufficiently funded and full payment to contractors only made after evidenced tree establishment (5 years after planting date). Funding spurious tree planting targets based on numbers of trees planted will not deliver vibrant, vital treescapes for future generations.

Recommended actions:

- Require species suitability assessment, aftercare and establishment monitoring in funding agreements.
- Redesign grants and contracts to reward successful tree establishment (typically 5 years post-planting), not initial planting.
- Phase out numeric "trees planted" targets in favour of establishment success rate.

4. *Adopt a London tree data standard*

Tree demographic analysis will be made much more efficient and robust if a shared data standard is adopted. Indeed, accuracy in the outcomes of this report has been reduced by the quality of the underlying tree inventory data – despite it being the best available. Therefore, a Greater London Authority tree data standard should be adopted to support urban forest managers with accurate information. As a minimum: a nomenclature standard (for example, the taxonomic backbone of *Plants of the world online*[20]) and a standard way to measure tree dimensions should be agreed. It is also important to record tree mortality rates in a structured way to help evaluate any systemic failure as a function of species or management protocol.

Recommended action:

- Implement a London-wide tree data framework covering taxonomy, measurement methods, and mortality reporting.

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5. *Collaborate with tree nurseries*

The provision of trees for our urban forest relies upon a supply chain from tree nurseries. To ensure that the correct species are available for purchase by London's urban forest managers, it is critical that there continues to be an active dialogue between the nursery sector and Local Authorities. As the lead-time for

[20] See: https://powo.science.kew.org/).

'standard' size street trees is often between five to ten years – and could be longer – it is essential that nurseries have clear guidance from tree specifiers regarding the species palettes they require. To ensure availability of the most suitable species, Local Authorities should seek to contract grow these trees with nurseries, setting specific procurement targets for contract growing and collaborating across the Greater London Authority to achieve the economies of scale necessary to guarantee that suitable tree species are available within a biosecure supply chain.

Recommended actions:

- Provide nurseries with clear guidance on required species palettes.
- Establish nursery partnerships and contract-growing agreements to secure long-term supply of future climate-suitable and biosecure trees.
- Use collective London-level procurement to achieve economies of scale and ensure consistent stock quality.
- Where feasible, support climate-adapted tree production initiatives within London.

6. Develop a strategic mechanism to get novel plant material into horticultural production.

The suitability of trees for London's future urban forest is a function of species and provenance. Unfortunately, knowledge of provenance (region of origin) is absent from most commercially produced trees. In many cases, particularly those identified as having 'Low' or 'Moderate' suitability in this report, targeted provenance selection is very likely to increase the compatibility with future climate scenarios. Research aimed at understanding intraspecific variation in plant traits and provenance selection using species distribution modelling aimed at selecting optimal plant reproductive material for London's future climate should be prioritised.

Whilst working within the constraints of the Nagoya Protocol (Compliance) Regulations 2015[21], mechanisms that facilitate the strategic introduction of new material into the horticultural trade via current botanic gardens and new, targeted collection expeditions.

Recommended actions:

- Work with government bodies and industry to develop compliant mechanisms to introduce and trial new species and provenances suitable for future conditions.
- Support research on intraspecific variation in plant traits and targeted provenance selection to identify the most future climate-compatible planting material.
- Use botanic gardens and arboreta as hubs for research, testing, and knowledge transfer.

[21] Nagoya Protocol (Compliance) Regulations 2015

7. ~~Develop~~ Address gaps in plant trait data~~bases to inform tree selection~~

This analysis utilises global plant trait datasets to help inform tree tolerance to abiotic climate-related stress. However, many of the species did not have all relevant traits available, this resulted in a low confidence score for 65% of the outcome statements. Using this study as a gap analysis, research should prioritise the collection 'missing' trait (LDMC, WD, TLP) data in order to further improve the confidence of this analytical framework.

Recommended actions:

- Support further research to address the 'missing' trait data gaps in wood density, leaf dry-matter content, and turgor-loss point for under-represented species.
- Establish a framework for collaboration between research institutions, policymakers and industry to continue to improve the evidence base for urban species selection.

8. Evaluate potential ~~impact of this analysis on~~ canopy cover impacts of species climate suitability.

This report has delivered an analysis of tree suitability based on a taxonomic analysis. Variation in how tree dimensions are recorded, particularly the use of size classes (rather than actual tree dimensions) makes statements relating to potential impact on canopy cover difficult. Once a new data standard has been adopted, evaluating tree suitability for future climate through the prism of canopy cover will help prioritise species selection for future climate scenarios. Remote sensing surveys using technologies such as LiDAR could greatly aid this task, providing tree dimensions can be accurately paired to species.

Recommended actions:

- Once standardised data is adopted, use remote sensing (e.g. LiDAR) to map canopy structure and evaluate the impact of species selection on canopy cover.
- Further research could seek to model how species choice also affects shade, heat and/or carbon outcomes.

Commented [redacted]: These (as all above) are [redacted] suggestion: do adapt as you see fit.

9. Develop London-wide strategies and structures to manage the whole of London's urban forest

Landscapes are not defined by political boundaries, therefore, wherever practicable, London-wide strategies for urban forest management should be adopted. Organisations such as the London Urban Forest Partnership should be enabled to help achieve this.

Recommended action:

- Empower the London Urban Forest Partnership to coordinate data, investment, and planning for public realm trees across the city.

10. Apply this analytical framework to other cities and regions.

Leadership shown by the Greater London Authority and London's Urban Forest Partnership has enabled the development of a novel approach to tree suitability assessment. Other cities and regions could benefit from this approach to help inform their own contexts and ultimately ~~help move~~progress towards a national understanding of tree suitability to future climates, and inform a framework for action.~~to future climate scenarios~~.

- Recommended action: Roll out the methodology prototyped in London to assess the future climate suitability of trees to other UK cities and regions.
- Apply this analytical framework more widely to support a national evidence base for improving urban tree resilience and guide UK-wide adaptation policy.

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Limitations

Despite its strengths, this study acknowledges several limitations. Data gaps, including sparse occurrence records for some species, affect the precision of species distribution models. Additionally, whilst the inclusion of plant traits makes outcome statements more robust, some of the trait data clusters were estimated through expert judgement rather than derived from primary data sources. Transparency of this issue was addressed through the inclusion of a confidence score. Nevertheless. it is hoped that future research can reduce the data absences, mitigating this limitation in subsequent analyses.

Importantly. this analysis is only relevant for London and should only be considered accurate for this area. Climate projections, even within the same scenario vary across the UK so tree suitability from this study should not be inferred for other parts of the country which often have less consequential projections.

Commented [redacted]: Important to highlight this earlier in the report. I have included it in the exec summary. I think It should also be reiterated somewhere at the beginning of the results section.

Recommended species have only been taken from the database provided. Therefore, these are species that are comparatively under-represented within London but currently available. We have refrained from advocating novel species that are not available to avoid incentivising importation of plant material from beyond UK borders. As recommended by this report, we are seeking to work with UK tree nurseries to bring novel tree species into production in a sustainable and ethical way.

N.B. Executive summary placed at the front of the document.

Appendix 1 – Supplementary Data

To ensure transparency and repeatability of the analysis, the data cleaning stages are recorded here. First, we removed observations that were too high.

Box 1: Removed observation data

'Acizzia', 'Anacardiaceae', 'Araliaceae', 'Arecaceae', 'Arecales', 'Bignoniaceae', 'Biota', 'Cannabaceae', 'Caprifoliaceae', 'Celastraceae', 'Chlorophyta', 'Cudoniella acicularis', 'Cupressaceae', 'Digitalis purpurea', 'Ericales', 'Exochorda', 'Fabaceae', 'Fallopia baldschuanica', 'Fallopia japonica', 'Garryales', 'Geometridae', 'Gymnodinium chiastosporum', 'Gymnodiniaceae', 'Hippothoa', 'Homona coffearia', 'Ipimorpha subtusa', 'Lauraceae', 'Lythraceae', 'Melianthaceae', 'Moraceae', 'Myrtaceae', 'Oleaceae', 'Pica', 'Pinaceae', 'Pinales', 'Pinophyta', 'Pinopsida', 'Plantae', 'Rosa', 'Rosacea', 'Rutaceae', 'Sapindales', 'Saxifragaceae', 'Saxifragales', 'Subacronicta megacephala', 'Ulmaceae', 'Zabrachia tenella'

N.B. - Some records from these groups are included, but the observations were removed where only the botanical order or family information was included as such a coarse level of resolution is not helpful in subsequent analysis.

Next it was important to harmonise hybrid names in order that names were recorded in a consistent way so that the same hybrid was not recorded in two different ways (Box 2).

Box 2 : Harmonised hybrid names

"Arbutus unedo x andrachne = A. x andrachnoides" = "Arbutus x andrachnoides",
"Berberis darwinii x empetrifolia = B. x stenophylla" = "Berberis x stenophylla",
"Cotoneaster frigidus x salicifolius = C. x watereri" = "Cotoneaster x watereri",
"Cotoneaster salicifolius x dammeri = C. 'Hybridus Pendulus'" = "Cotoneaster Hybridus Pendulus",
"Cupressus macrocarpa x Xanthocyparis nootkatensis = X Cuprocyparis leylandi" = "X Cuprocyparis leylandii",
"Forsythia suspensa x viridissima = F. x intermedia" = "Forsythia x intermedia",
"Ilex aquifolium x perado = I. x altaclerensis" = "Ilex x altaclerensis",
"Laburnum anagyroides x alpinum = L. x watereri" = "Laburnum x watereri",
"Larix decidua x kaempferi = L. x marschlinsii" = "Larix x marschlinsii",
"Malus atrosanguinea x niedzwetskyana = M. x purpurea" = "Malus x purpurea",
"Malus baccata x prunifolia = M. x robusta" = "Malus x robusta",
"Osmanthus decorus x delavayi = O. x burkwoodii" = "Osmanthus x burkwoodii",

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"Platanus occidentalis x orientalis = P. x hispanica" = "Platanus x hispanica",
"Populus alba x tremula = P. x canescens" = "Populus x canescens",
"Populus balsamifera x deltoides = P. x jackii" = "Populus x jackii",
"Populus nigra x deltoides = P. x canadensis" = "Populus x canadensis",
"Populus nigra x laurifolia = P. x berolinensis" = "Populus x berolinensis",
"Prunus spinosa x domestica = P. x fruticans" = "Prunus x fruticans",
"Pterocarya fraxinifolia x stenoptera (P. x rehderiana)" = "Pterocarya x rehderiana",
"Quercus cerris x suber = Q. x crenata" = "Quercus x crenata",
"Salix alba x babylonica = S. x sepulcralis" = "Salix x sepulcralis",
"Salix euxina x alba = S. x fragilis" = "Salix x fragilis",
"Sorbus aucuparia x aria = S. x thuringiaca" = "Sorbus x thuringiaca",
"Tilia cordata x dasystyla = T. x euchlora" = "Tilia x euchlora",
"Tilia platyphyllos x cordata = T. x europaea" = "Tilia x europaea",
"Ulmus glabra x minor x plotii = U. x hollandica" = "Ulmus x hollandica",
"Viburnum farreri x grandiflorum = V. x bodnantense" = "Viburnum x bodnantense",
"Viburnum lantana x rhytidophyllum = V. x rhytidophylloides" = "Viburnum x rhytidophylloides"

As the analysis for this report cannot resolve cultivar resilience scores, the cultivars present in the dataframe were recoded to represent the species level.

Box 3: Cultivars recoded to species

"Acer platanoides 'Drummondii'" = "Acer platanoides",
"Acer platanoides 'Schwedleri'" = "Acer platanoides",
"Acer pseudoplatanus 'Brilliantissimum'" = "Acer pseudoplatanus",
"Acer pseudoplatanus 'Leopoldii'" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma erythrocarpum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma purpureum" = "Acer pseudoplatanus",
"Acer pseudoplatanus forma variegatum" = "Acer pseudoplatanus",
"Betula pendula 'Laciniata'" = "Betula pendula",
"Betula pubescens Ehrh. var. pubescens" = "Betula pubescens",
"Chamaecyparis lawsoniana 'Erecta Viridis'" = "Chamaecyparis lawsoniana",
"Cupressus arizonica var. glabra" = "Cupressus arizonica",
"Fagus sylvatica 'Asplenifolia'" = "Fagus sylvatica",
"Fagus sylvatica 'Dawyck'" = "Fagus sylvatica",
"Fagus sylvatica 'Pendula'" = "Fagus sylvatica",

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"Fagus sylvatica 'Purpurea'" = "Fagus sylvatica",
"Fagus sylvatica Heterophylla group" = "Fagus sylvatica",
"Fraxinus angustifolia 'Raywood'" = "Fraxinus angustifolia",
"Fraxinus angustifolia subsp. oxycarpa" = "Fraxinus angustifolia",
"Fraxinus excelsior 'Diversifolia'" = "Fraxinus excelsior",
"Fraxinus excelsior 'Jaspidea'" = "Fraxinus excelsior",
"Mespilus germanica 'Nottingham'" = "Mespilus germanica",
"Pinus contorta var. latifolia" = "Pinus contorta",
"Pinus nigra subsp. laricio" = "Pinus nigra",
"Platanus" = "Platanus x hispanica",
"Populus candicans" = "Populus x candicans",
"Populus candicans 'Aurora'" = "Populus x candicans",
"Populus nigra 'Italica'" = "Populus nigra",
"Populus nigra 'Plantierensis'" = "Populus nigra",
"Populus nigra subsp. betulifolia" = "Populus nigra",
"Populus x canadensis 'Marilandica'" = "Populus x canadensis",
"Populus x canadensis 'Regenerata'" = "Populus x canadensis",
"Populus x canadensis 'Serotina'" = "Populus x canadensis",
"Prunus avium 'Plena'" = "Prunus avium",
"Prunus cerasifera var. pissardii" = "Prunus cerasifera",
"Prunus domestica subsp. insititia" = "Prunus domestica",
"Prunus Maackii" = "Prunus maackii",
"Quercus robur forma fastigiata" = "Quercus robur",
"Salix cinerea subsp. oleifolia" = "Salix cinerea",
"Salix x sepulcralis 'Chrysocoma'" = "Salix x sepulcralis",
"Taxodium" = "Taxodium distichum",
"Taxus baccata 'Fastigiata'" = "Taxus baccata",
"Tilia platyphyllos 'Rubra'" = "Tilia platyphyllos",
"Tilia 'Petiolaris'" = "Tilia tomentosa",
"Tilia tomentosa 'Petiolaris'" = "Tilia tomentosa",
"Ulmus glabra 'Exoniensis'" = "Ulmus glabra",
"Ulmus glabra 'Horizontalis' (Pendula)" = "Ulmus glabra",
"Ulmus minor agg." = "Ulmus minor",
"Ulmus minor subsp. minor" = "Ulmus minor"
"X Cuprocyparis" = "X Cuprocyparis leylandii",
"X Cupressocyparis" = "X Cuprocyparis leylandii",
"X Cuprocyparis leylandi" = "X Cuprocyparis leylandii",
"Yucca" = "Yucca filamentosa"
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Finally, the shrub and climber species were removed.

Box 4: Shrub and climber observations that have been removed

'Azara', 'Berberis darwinii', 'Berberis x stenophylla', 'Berberis . x stenophylla', 'Buddleja', 'Buddleja alternifolia', 'Buddleja davidii', 'Camelina', 'Camellia', 'Ceanothus', 'Cordyline australis', 'Corylus avellana', 'Corylus maxima', 'Cotinus', 'Cotinus coggygria', 'Cotoneaster', 'Cotoneaster Hybridus Pendulus', 'Cotoneaster conspicuus', 'Cotoneaster franchetii', 'Cotoneaster integrifolius', 'Cotoneaster salicifolius', 'Cotoneaster x watereri', 'Cytisus', 'Cytisus battandieri', 'Cytisus scoparius', 'Elaeagnus umbellata', 'Euonymus europaeus', 'Euonymus japonicus', 'Euonymus latifolius', 'Forsythia', 'Forsythia x intermedia', 'Frangula alnus', 'Fremontodendron californicum', 'Genista aetnensis', 'Genista hispanica', 'Griselinia', 'Griselinia littoralis', 'Hedera', 'Hedera helix', 'Homona coffearia', 'Hippophae rhamnoides', 'Ligustrum ovalifolium', 'Ligustrum vulgare', 'Lonicera periclymenum', 'Luma apiculata', 'Mahonia', 'Osmanthus', 'Osmanthus heterophyllus', 'Osmanthus x burkwoodii', 'Philadelphus', 'Philadelphus coronarius', 'Phillyrea latifolia', 'Photinia', 'Photinia davidiana', 'Pittosporum', 'Pittosporum tenuifolium', 'Pyracantha', 'Pyracantha atalantoides', 'Pyracantha coccinea', 'Rhamnus', 'Rhamnus cathartica', 'Rhododendron', 'Rhododendron ponticum', 'Ribes', 'Ribes sanguineum', 'Rosa canina', 'Rosa rugosa', 'Rubus cockburnianus', 'Rubus fruticosus agg.', 'Sambucus nigra', 'Viburnum', 'Viburnum davidii', 'Viburnum lantana', 'Viburnum opulus', 'Viburnum rhytidophyllum', 'Viburnum tinus', 'Viburnum x bodnantense', 'Viburnum x rhytidophylloides', Viburnum lantana x rhytidophyllum', 'Viburnum farreri x grandiflorum', 'Viburnum lantana x rhytidophyllum', 'Viburnum farreri x grandiflorum ', 'Viburnum lantana x rhytidophyllum', 'Wisteria sinensis'.

Table A1: List of tree species in London's public realm trees with relative counts and percentage data. Data is ordered alphabetically by family name. N.B. Some of the 'Species' are recorded as Genus, but these have been preserved as 'Species' to give a more accurate summary of the dataset.

Family [TaxonFamily]	Species [TaxonName]	Count of species	Percentage of species
Altingiaceae	*Liquidambar styraciflua*	9562	0.8
Anacardiaceae	*Rhus typhina*	351	0.03
Aquifoliaceae	*Ilex*	1276	0.1
Aquifoliaceae	*Ilex aquifolium*	13706	1.2
Aquifoliaceae	*Ilex x altaclerensis*	849	0.07
Araliaceae	*Aralia elata*	16	0.001
Araucariaceae	*Araucaria araucana*	103	0.009
Araucariaceae	*Wollemia nobilis*	7	0.0006
Arecaceae	*Phoenix dactylifera*	3	0.0003
Arecaceae	*Trachycarpus fortunei*	94	0.008
Asparagaceae	*Yucca filamentosa*	11	0.0009
Betulaceae	*Alnus*	941	0.08
Betulaceae	*Alnus cordata*	6183	0.5
Betulaceae	*Alnus glutinosa*	5945	0.5
Betulaceae	*Alnus incana*	2270	0.2
Betulaceae	*Alnus rubra*	137	0.01
Betulaceae	*Alnus viridis*	28	0.002
Betulaceae	*Betula*	10566	0.9
Betulaceae	*Betula alba*	26	0.002
Betulaceae	*Betula albosinensis*	1595	0.1
Betulaceae	*Betula jacquemontii*	2550	0.2
Betulaceae	*Betula lenta*	26	0.002
Betulaceae	*Betula maximowiczii*	84	0.007

Betulaceae	*Betula nana*	1	0.0001
Betulaceae	*Betula nigra*	1291	0.1
Betulaceae	*Betula papyrifera*	1760	0.2
Betulaceae	*Betula pendula*	31530	2.7
Betulaceae	*Betula pubescens*	3984	0.3
Betulaceae	*Betula utilis*	6920	0.6
Betulaceae	*Carpinus betulus*	35029	3.0
Betulaceae	*Corylus colurna*	6022	0.5
Betulaceae	*Ostrya carpinifolia*	662	0.06
Bignoniaceae	*Catalpa bignonioides*	1648	0.1
Bignoniaceae	*Chitalpa taschkentensis*	158	0.01
Buxaceae	*Buxus sempervirens*	211	0.02
Cannabaceae	*Celtis australis*	1411	0.1
Celastraceae	*Euonymus*	10	0.0009
Cercidiphyllaceae	*Cercidiphyllum japonicum*	257	0.02
Cornaceae	*Cornus*	256	0.02
Cornaceae	*Cornus alba*	49	0.004
Cornaceae	*Cornus alternifolia*	1	0.0001
Cornaceae	*Cornus florida*	6	0.0005
Cornaceae	*Cornus kousa*	124	0.01
Cornaceae	*Cornus mas*	509	0.04
Cornaceae	*Cornus sanguinea*	52	0.004
Cornaceae	*Davidia involucrata*	149	0.01
Cupressaceae	*Austrocedrus chilensis*	1	0.0001
Cupressaceae	*Calocedrus decurrens*	94	0.008
Cupressaceae	*Chamaecyparis*	865	0.07
Cupressaceae	*Chamaecyparis lawsoniana*	8314	0.7

Cupressaceae	*Chamaecyparis obtusa*	48	0.004
Cupressaceae	*Chamaecyparis pisifera*	26	0.002
Cupressaceae	*Cryptomeria japonica*	96	0.008
Cupressaceae	*Cupressus*	3809	0.3
Cupressaceae	*Cupressus arizonica*	15	0.001
Cupressaceae	*Cupressus lawsoniana*	210	0.02
Cupressaceae	*Cupressus macrocarpa*	709	0.06
Cupressaceae	*Cupressus sempervirens*	63	0.005
Cupressaceae	*X Cuprocyparis leylandii*	5777	0.5
Cupressaceae	*Hesperocyparis glabra*	78	0.007
Cupressaceae	*Juniperus*	90	0.008
Cupressaceae	*Juniperus chinensis*	26	0.002
Cupressaceae	*Juniperus communis*	126	0.01
Cupressaceae	*Juniperus virginiana*	26	0.002
Cupressaceae	*Metasequoia glyptostroboides*	1429	0.1
Cupressaceae	*Platycladus orientalis*	15	0.001
Cupressaceae	*Sequoia sempervirens*	194	0.02
Cupressaceae	*Sequoiadendron giganteum*	541	0.05
Cupressaceae	*Taxodium distichum*	475	0.04
Cupressaceae	*Thuja*	67	0.006
Cupressaceae	*Thuja occidentalis*	16	0.001
Cupressaceae	*Thuja plicata*	1546	0.1
Cupressaceae	*Thujopsis dolabrata*	6	0.0005
Cupressaceae	*Xanthocyparis nootkatensis*	30	0.003
Dicksoniaceae	*Dicksonia antarctica*	4	0.0003
Elaeagnaceae	*Elaeagnus angustifolia*	18	0.002
Elaeagnaceae	*Hippophae*	57	0.005

Ericaceae	*Arbutus unedo*	275	0.02
Fabaceae	*Acacia*	120	0.01
Fabaceae	*Acacia dealbata*	17	0.001
Fabaceae	*Acacia melanoxylon*	4	0.0003
Fabaceae	*Acacia pravissima*	2	0.0002
Fabaceae	*Caragana arborescens*	2	0.0002
Fabaceae	*Cercis siliquastrum*	784	0.07
Fabaceae	*Gleditsia triacanthos*	4073	0.3
Fabaceae	*Laburnum*	264	0.02
Fabaceae	*Laburnum alpinum*	4	0.0003
Fabaceae	*Laburnum anagyroides*	866	0.07
Fabaceae	*Laburnum x watereri*	177	0.02
Fabaceae	*Robinia pseudoacacia*	13208	1.1
Fabaceae	*Sophora microphylla*	1	0.0001
Fabaceae	*Sophora tetraptera*	12	0.001
Fabaceae	*Styphnolobium japonicum*	37	0.003
Fabaceae	*Ulex europaeus*	1	0.0001
Fagaceae	*Castanea sativa*	5710	0.5
Fagaceae	*Fagus*	136	0.01
Fagaceae	*Fagus orientalis*	9	0.0008
Fagaceae	*Fagus sylvatica*	10478	0.9
Fagaceae	*Quercus*	4181	0.4
Fagaceae	*Quercus alba*	2	0.0002
Fagaceae	*Quercus castaneifolia*	82	0.007
Fagaceae	*Quercus cerris*	3725	0.3
Fagaceae	*Quercus coccinea*	341	0.03
Fagaceae	*Quercus frainetto*	163	0.01

Fagaceae	*Quercus ilex*	2953	0.3
Fagaceae	*Quercus imbricaria*	1	0.0001
Fagaceae	*Quercus palustris*	987	0.08
Fagaceae	*Quercus petraea*	344	0.03
Fagaceae	*Quercus phellos*	28	0.002
Fagaceae	*Quercus phillyreoides*	1	0.0001
Fagaceae	*Quercus pubescens*	1	0.0001
Fagaceae	*Quercus robur*	66892	5.7
Fagaceae	*Quercus rubra*	2580	0.2
Fagaceae	*Quercus suber*	112	0.01
Fagaceae	*Quercus velutina*	2	0.0002
Fagaceae	*Quercus x crenata*	45	0.004
Fagaceae	*Quercus x turneri*	38	0.003
Garryaceae	*Garrya elliptica*	17	0.001
Ginkgoaceae	*Ginkgo biloba*	5524	0.5
Hamamelidaceae	*Parrotia persica*	1528	0.1
Juglandaceae	*Carya*	127	0.01
Juglandaceae	*Carya cordiformis*	2	0.0002
Juglandaceae	*Carya illinoensis*	2	0.0002
Juglandaceae	*Carya ovata*	8	0.0007
Juglandaceae	*Juglans*	25	0.002
Juglandaceae	*Juglans nigra*	521	0.04
Juglandaceae	*Juglans regia*	1424	0.1
Juglandaceae	*Pterocarya*	9	0.0008
Juglandaceae	*Pterocarya fraxinifolia*	393	0.03
Juglandaceae	*Pterocarya x rehderiana*	11	0.0009
Lamiaceae	*Clerodendrum trichotomum*	202	0.02

Lauraceae	*Laurus*	76	0.007
Lauraceae	*Laurus nobilis*	1058	0.09
Lauraceae	*Persea americana*	2	0.0002
Lauraceae	*Umbellularia californica*	4	0.0003
Magnoliaceae	*Liriodendron tulipifera*	2529	0.2
Magnoliaceae	*Magnolia*	4276	0.4
Magnoliaceae	*Magnolia acuminata*	12	0.001
Magnoliaceae	*Magnolia grandiflora*	31	0.003
Malvaceae	*Hibiscus syriacus*	435	0.04
Malvaceae	*Tilia*	21562	1.8
Malvaceae	*Tilia americana*	171	0.01
Malvaceae	*Tilia cordata*	17314	1.5
Malvaceae	*Tilia platyphyllos*	11252	1.0
Malvaceae	*Tilia tomentosa*	1123	0.1
Malvaceae	*Tilia x euchlora*	5036	0.4
Malvaceae	*Tilia x europaea*	45204	3.9
Moraceae	*Broussonetia papyrifera*	24	0.002
Moraceae	*Ficus carica*	437	0.04
Moraceae	*Morus*	13	0.001
Moraceae	*Morus alba*	342	0.03
Moraceae	*Morus nigra*	393	0.03
Myrtaceae	*Eucalyptus*	204	0.02
Myrtaceae	*Eucalyptus coccifera*	28	0.002
Myrtaceae	*Eucalyptus globulus*	10	0.0009
Myrtaceae	*Eucalyptus gunnii*	620	0.05
Myrtaceae	*Eucalyptus niphophila*	33	0.003
Myrtaceae	*Eucalyptus pauciflora*	2	0.0002

Myrtaceae	*Eucalyptus perriniana*	1	0.0001
Nothofagaceae	*Nothofagus*	27	0.002
Nothofagaceae	*Nothofagus alpina*	11	0.0009
Nothofagaceae	*Nothofagus antarctica*	149	0.01
Nothofagaceae	*Nothofagus dombeyi*	17	0.001
Nothofagaceae	*Nothofagus obliqua*	73	0.006
Nyssaceae	*Nyssa sylvatica*	147	0.01
Oleaceae	*Fraxinus*	6544	0.6
Oleaceae	*Fraxinus americana*	365	0.03
Oleaceae	*Fraxinus angustifolia*	1858	0.2
Oleaceae	*Fraxinus excelsior*	53362	4.6
Oleaceae	*Fraxinus latifolia*	15	0.001
Oleaceae	*Fraxinus ornus*	2461	0.2
Oleaceae	*Fraxinus pennsylvanica*	56	0.005
Oleaceae	*Fraxinus velutina*	7	0.0006
Oleaceae	*Ligustrum*	2042	0.2
Oleaceae	*Ligustrum lucidum*	1359	0.1
Oleaceae	*Ligustrum sinensis*	22	0.002
Oleaceae	*Olea europaea*	338	0.03
Oleaceae	*Syringa vulgaris*	729	0.06
Paulowniaceae	*Paulownia tomentosa*	589	0.05
Pinaceae	*Abies*	112	0.01
Pinaceae	*Abies alba*	109	0.009
Pinaceae	*Abies cephalonica*	3	0.0003
Pinaceae	*Abies concolor*	4	0.0003
Pinaceae	*Abies delavayi*	2	0.0002
Pinaceae	*Abies fraseri*	24	0.002

Pinaceae	*Abies grandis*	83	0.007
Pinaceae	*Abies koreana*	12	0.001
Pinaceae	*Abies lasiocarpa*	6	0.0005
Pinaceae	*Abies nordmanniana*	16	0.001
Pinaceae	*Abies procera*	35	0.003
Pinaceae	*Cedrus*	260	0.02
Pinaceae	*Cedrus atlantica*	1208	0.1
Pinaceae	*Cedrus brevifolia*	9	0.0008
Pinaceae	*Cedrus deodara*	813	0.07
Pinaceae	*Cedrus libani*	475	0.04
Pinaceae	*Larix*	115	0.01
Pinaceae	*Larix decidua*	464	0.04
Pinaceae	*Larix kaempferi*	49	0.004
Pinaceae	*Larix x marschlinsii*	42	0.004
Pinaceae	*Picea*	69	0.006
Pinaceae	*Picea abies*	537	0.05
Pinaceae	*Picea breweriana*	12	0.001
Pinaceae	*Picea glauca*	15	0.001
Pinaceae	*Picea obovata*	1	0.0001
Pinaceae	*Picea omorika*	56	0.005
Pinaceae	*Picea orientalis*	2	0.0002
Pinaceae	*Picea pungens*	45	0.004
Pinaceae	*Picea sitchensis*	11	0.0009
Pinaceae	*Picea smithiana*	4	0.0003
Pinaceae	*Pinus*	1045	0.09
Pinaceae	*Pinus cembra*	8	0.0007
Pinaceae	*Pinus contorta*	7	0.0006

Pinaceae	*Pinus mugo*	34	0.003
Pinaceae	*Pinus muricata*	1	0.0001
Pinaceae	*Pinus nigra*	3553	0.3
Pinaceae	*Pinus peuce*	6	0.0005
Pinaceae	*Pinus pinaster*	29	0.002
Pinaceae	*Pinus pinea*	254	0.02
Pinaceae	*Pinus ponderosa*	13	0.001
Pinaceae	*Pinus radiata*	106	0.009
Pinaceae	*Pinus strobus*	59	0.005
Pinaceae	*Pinus sylvestris*	5892	0.5
Pinaceae	*Pinus wallichiana*	123	0.01
Pinaceae	*Pinus x holfordiana*	7	0.0006
Pinaceae	*Pseudotsuga menziesii*	68	0.006
Pinaceae	*Tsuga*	2	0.0002
Pinaceae	*Tsuga canadensis*	3	0.0003
Pinaceae	*Tsuga heterophylla*	15	0.001
Platanaceae	*Platanus occidentalis*	23	0.002
Platanaceae	*Platanus orientalis*	822	0.07
Platanaceae	*Platanus x hispanica*	77569	6.6
Rosaceae	*Amelanchier*	7855	0.7
Rosaceae	*Amelanchier lamarckii*	3286	0.3
Rosaceae	*Amelanchier ovalis*	67	0.006
Rosaceae	*Cotoneaster frigidus*	415	0.04
Rosaceae	*Cotoneaster salicifolius*	8	0.0007
Rosaceae	*Crataegus*	5195	0.4
Rosaceae	*Crataegus coccinea*	6	0.0005
Rosaceae	*Crataegus crus-galli*	1245	0.1

Rosaceae	*Crataegus laevigata*	3163	0.3
Rosaceae	*Crataegus mollis*	25	0.002
Rosaceae	*Crataegus monogyna*	27542	2.4
Rosaceae	*Crataegus persimilis*	3007	0.3
Rosaceae	*Crataegus punctata*	3	0.0003
Rosaceae	*Crataegus succulenta*	8	0.0007
Rosaceae	*Crataegus x lavallei*	1874	0.2
Rosaceae	*Cydonia oblonga*	77	0.007
Rosaceae	*Hedlundia mougeotii*	11	0.0009
Rosaceae	*Malus*	25652	2.2
Rosaceae	*Malus baccata*	1350	0.1
Rosaceae	*Malus domestica*	75	0.006
Rosaceae	*Malus floribunda*	983	0.08
Rosaceae	*Malus hupehensis*	400	0.03
Rosaceae	*Malus niedzwetzkyana*	1	0.0001
Rosaceae	*Malus prunifolia*	118	0.01
Rosaceae	*Malus pumila*	1930	0.2
Rosaceae	*Malus robusta*	32	0.003
Rosaceae	*Malus sieboldii*	9	0.0008
Rosaceae	*Malus sylvestris*	2346	0.2
Rosaceae	*Malus x purpurea*	1672	0.1
Rosaceae	*Mespilus germanica*	540	0.05
Rosaceae	*Prunus*	87837	7.5
Rosaceae	*Prunus armeniaca*	2	0.0002
Rosaceae	*Prunus avium*	31803	2.7
Rosaceae	*Prunus cerasifera*	21472	1.8
Rosaceae	*Prunus cerasus*	59	0.005

Rosaceae	Prunus domestica	1622	0.1
Rosaceae	Prunus dulcis	586	0.05
Rosaceae	Prunus incisa	68	0.006
Rosaceae	Prunus laurocerasus	1912	0.2
Rosaceae	Prunus lusitanica	808	0.07
Rosaceae	Prunus maackii	539	0.05
Rosaceae	Prunus padus	4936	0.4
Rosaceae	Prunus persica	25	0.002
Rosaceae	Prunus serotina	29	0.002
Rosaceae	Prunus serrulata	12436	1.1
Rosaceae	Prunus spinosa	1856	0.2
Rosaceae	Prunus x fruticans	2157	0.2
Rosaceae	Pyrus	22769	1.9
Rosaceae	Pyrus calleryana	2701	0.2
Rosaceae	Pyrus communis	2790	0.2
Rosaceae	Pyrus cordata	7	0.0006
Rosaceae	Pyrus pyraster	5	0.0004
Rosaceae	Pyrus salicifolia	301	0.03
Rosaceae	Sorbaria tomentosa	2	0.0002
Rosaceae	Sorbus	8473	0.7
Rosaceae	Sorbus 'Joseph Rock'	182	0.02
Rosaceae	Sorbus aria	12600	1.1
Rosaceae	Sorbus aucuparia	17829	1.5
Rosaceae	Sorbus commixta	514	0.04
Rosaceae	Sorbus domestica	149	0.01
Rosaceae	Sorbus glabriuscula	242	0.02
Rosaceae	Sorbus intermedia	9788	0.8

Rosaceae	*Sorbus latifolia*	200	0.02
Rosaceae	*Sorbus pseudohupehensis*	12	0.001
Rosaceae	*Sorbus sargentiana*	19	0.002
Rosaceae	*Sorbus thibetica*	15	0.001
Rosaceae	*Sorbus torminalis*	708	0.06
Rosaceae	*Sorbus vilmorinii*	16	0.001
Rosaceae	*Sorbus x thuringiaca*	1473	0.1
Rutaceae	*Citrus trifoliata*	6	0.0005
Salicaceae	*Populus*	5396	0.5
Salicaceae	*Populus alba*	2599	0.2
Salicaceae	*Populus balsamifera*	691	0.06
Salicaceae	*Populus canescens*	274	0.02
Salicaceae	*Populus deltoides*	1	0.0001
Salicaceae	*Populus laurifolia*	3	0.0003
Salicaceae	*Populus nigra*	8481	0.7
Salicaceae	*Populus tremula*	1756	0.2
Salicaceae	*Populus tremuloides*	21	0.002
Salicaceae	*Populus trichocarpa*	65	0.006
Salicaceae	*Populus x berolinensis*	1	0.0001
Salicaceae	*Populus x canadensis*	1240	0.1
Salicaceae	*Populus x candicans*	54	0.005
Salicaceae	*Populus x canescens*	707	0.06
Salicaceae	*Populus x jackii*	30	0.003
Salicaceae	*Populus yunnanensis*	1	0.0001
Salicaceae	*Salix*	4499	0.4
Salicaceae	*Salix alba*	2768	0.2
Salicaceae	*Salix babylonica*	1513	0.1

Salicaceae	*Salix caprea*	3030	0.3
Salicaceae	*Salix cinerea*	68	0.006
Salicaceae	*Salix daphnoides*	9	0.0008
Salicaceae	*Salix matsudana*	260	0.02
Salicaceae	*Salix pentandra*	14	0.001
Salicaceae	*Salix viminalis*	2	0.0002
Salicaceae	*Salix x fragilis*	2773	0.2
Salicaceae	*Salix x pendulina*	1	0.0001
Salicaceae	*Salix x sepulcralis*	129	0.01
Sapindaceae	*Acer*	8417	0.7
Sapindaceae	*Acer campestre*	31019	2.7
Sapindaceae	*Acer cappadocicum*	1411	0.1
Sapindaceae	*Acer davidii*	290	0.02
Sapindaceae	*Acer griseum*	176	0.02
Sapindaceae	*Acer hersii*	5	0.0004
Sapindaceae	*Acer japonicum*	79	0.007
Sapindaceae	*Acer macrophyllum*	4	0.0003
Sapindaceae	*Acer monspessulanum*	40	0.003
Sapindaceae	*Acer negundo*	2433	0.2
Sapindaceae	*Acer opalus*	9	0.0008
Sapindaceae	*Acer palmatum*	368	0.03
Sapindaceae	*Acer platanoides*	55775	4.8
Sapindaceae	*Acer pseudoplatanus*	52510	4.5
Sapindaceae	*Acer rubrum*	1252	0.1
Sapindaceae	*Acer rufinerve*	28	0.002
Sapindaceae	*Acer saccharinum*	6275	0.5
Sapindaceae	*Acer saccharum*	800	0.07

Sapindaceae	*Acer tataricum*	9	0.0008
Sapindaceae	*Aesculus*	569	0.05
Sapindaceae	*Aesculus flava*	163	0.01
Sapindaceae	*Aesculus hippocastanum*	23652	2.0
Sapindaceae	*Aesculus indica*	1001	0.09
Sapindaceae	*Aesculus parviflora*	9	0.0008
Sapindaceae	*Aesculus pavia*	45	0.004
Sapindaceae	*Aesculus turbinata*	4	0.0003
Sapindaceae	*Aesculus x carnea*	2194	0.2
Sapindaceae	*Koelreuteria paniculata*	1633	0.1
Simaroubaceae	*Ailanthus altissima*	3795	0.3
Styracaceae	*Styrax japonicus*	7	0.0006
Tamaricaceae	*Tamarix*	37	0.003
Tamaricaceae	*Tamarix africana*	26	0.002
Tamaricaceae	*Tamarix gallica*	29	0.002
Tamaricaceae	*Tamarix parviflora*	14	0.001
Tamaricaceae	*Tamarix tetrandra*	85	0.007
Taxaceae	*Cephalotaxus fortunei*	12	0.001
Taxaceae	*Taxus baccata*	8982	0.8
Ulmaceae	*Ulmus*	4332	0.4
Ulmaceae	*Ulmus glabra*	1008	0.09
Ulmaceae	*Ulmus laevis*	28	0.002
Ulmaceae	*Ulmus minor*	340	0.03
Ulmaceae	*Ulmus procera*	5951	0.5
Ulmaceae	*Ulmus x hollandica*	119	0.01
Ulmaceae	*Zelkova*	12	0.001
Ulmaceae	*Zelkova carpinifolia*	198	0.02

Ulmaceae	*Zelkova serrata*	789	0.07

APPENDIX 2

We could add the 101 TDAG Species profiles for the suitable (high and moderate suitability) species. Thoughts welcome.

High suitability species

1. *Acer monspessulanum,*
2. *Acer tataricum,*
3. *Arbutus unedo,*
4. *Cupressus arizonica,*
5. *Cupressus macrocarpa,*
6. *Eucommia ulmoides,*
7. *Olea europaea,*
8. *Ostrya carpinifolia,*
9. *Parrotia persica,*
10. *Quercus frainetto,*
11. *Quercus ilex,*
12. *Quercus suber,*
13. ***Sorbus torminalis**,*
14. *Tamarix ramosissima*

Moderate suitability species

1. *Abies concolor,*
2. *Acacia dealbata,*
3. *Acer buergerianum,*
4. *Acer cappadocicum,*
5. *Acer davidii,*
6. *Acer griseum,*
7. *Acer negundo,*
8. *Aesculus indica,*
9. *Aesculus pavia,*
10. *Amelanchier alnifolia,*
11. *Betula albosinensis,*
12. *Betula jacquemontii,*
13. *Betula papyrifera,*
14. *Betula utilis,*
15. *Buxus sempervirens,*
16. *Carya illinoinensis,*
17. *Catalpa bignonioides,*
18. *Catalpa speciosa,*
19. *Cedrus atlantica,*
20. *Cedrus deodara,*
21. *Cedrus libani,*
22. *Celtis australis,*
23. *Celtis occidentalis,*
24. *Cercis siliquastrum,*
25. *Chamaecyparis lawsoniana,*
26. *Corylus colurna,*
27. *Corylus maxima,*
28. *Crataegus x lavallei,*

29. ***Crataegus monogyna***,
30. *Crataegus x persimilis*,
31. *Cupressus sempervirens*,
32. *Cydonia oblonga*,
33. *Diospyros kaki*,
34. *Elaeagnus angustifolia*,
35. *Eucalyptus pauciflora*,
36. *Fagus orientalis*,
37. *Ficus carica*,
38. *Ginkgo biloba*,
39. *Gleditsia triacanthos*,
40. *Gymnocladus dioica*,
41. *Heptacodium miconioides*,
42. *Hippophae salicifolia*,
43. *Juglans nigra*,
44. *Juglans regia*,
45. *Juniperus scopulorum*,
46. *Juniperus virginiana*,
47. *Koelreuteria paniculata*,
48. *Ligustrum japonicum*,
49. *Ligustrum lucidum*,
50. *Malus baccata*,
51. *Malus yunnanensis*,
52. *Morus alba*,
53. *Morus nigra*,
54. *Nothofagus antarctica*,
55. *Paulownia tomentosa*,
56. *Picea pungens*,
57. *Pinus contorta*
58. *Pinus nigra*,
59. *Pinus pinaster*,
60. *Pinus pinea*,
61. *Pinus radiata*,
62. *Pinus wallichiana*,
63. *Platanus x hispanica*,
64. *Platanus orientalis*,
65. *Pseudotsuga menziesii*
66. *Prunus cerasifera*,
67. *Prunus dulcis*,
68. *Prunus maackii*,
69. *Prunus serrula*,
70. *Pyrus calleryana*,
71. *Pyrus communis*,
72. *Quercus castaneifolia*,
73. *Robinia pseudoacacia*,
74. *Sequoia sempervirens*,
75. *Sequoiadendron giganteum*,
76. *Sorbus discolor*,
77. *Sorbus vilmorinii*,
78. *Styphnolobium japonicum*,

79. *Syringa vulgaris*,
80. *Syringa reticulata*,
81. *Tamarix gallica*,
82. *Tamarix tetrandra*,
83. *Taxodium distichum*,
84. ***Taxus baccata*,**
85. *Tilia mongolica*,
86. *Ulmus* (resistant cultivars),
87. *X Cuprocyparis leylandii*