URBAN GREENING PLANNER

An Interactive Dashboard for Tree Planting in Vancouver

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Table of Contents

[Introduction 3](#_Toc209024196)

[Background 3](#_Toc209024197)

[Problem Statement 3](#_Toc209024198)

[Research Gap 3](#_Toc209024199)

[Assumptions 4](#_Toc209024200)

[Potential Benefits 4](#_Toc209024201)

[Proposed Research Project 4](#_Toc209024202)

[Objectives 4](#_Toc209024203)

[Justification 5](#_Toc209024204)

[Data Sources 5](#_Toc209024205)

[Data Analytics 5](#_Toc209024206)

[Technology Stack 6](#_Toc209024207)

[Expected Results 6](#_Toc209024208)

[Project Planning and Timeline 6](#_Toc209024209)

[Detailed Table 6](#_Toc209024210)

[Gantt Chart 8](#_Toc209024211)

[Project Contract 8](#_Toc209024212)

[Work Log Table 8](#_Toc209024213)

[Closing and References 9](#_Toc209024214)

[Closing 9](#_Toc209024215)

[Acknowledgement 9](#_Toc209024216)

[References 9](#_Toc209024217)

# Introduction

## Background

Urban forests are a vital part of city infrastructure, providing numerous ecological and social benefits. Trees clean the air, capture carbon, absorb rainwater, provide habitat, improve people’s health and well-being, and protect the city from storms, extreme heat, and the impacts of climate change. In Vancouver, the city maintains a large database of public trees, but tree coverage is uneven across neighbourhoods. This uneven distribution means that some communities lack the shade, air quality, and biodiversity benefits that trees bring.

## Problem Statement

While the city of Vancouver provides open datasets of public trees, this raw data is not easily interpretable for decision-making. Most existing reports are static and do not allow stakeholders to interact with the data to see where trees are missing and where planting should be prioritized. There is a need for a user-friendly, interactive tool that can analyze existing tree coverage and identify gaps across neighbourhoods.

## Research Gap

Current dashboards and reports provide high-level summaries of Vancouver’s canopy but rarely connect tree-level data with neighbourhood boundaries to compute actionable metrics such as tree density and species diversity. An interactive, data-driven tool that highlights planting priorities would support planners, community groups, and citizens.

## Assumptions

* The City of Vancouver’s public tree dataset and neighbourhood boundary data are reliable for this analysis.
* Tree density (trees/km²) and species diversity (Shannon index) are sufficient indicators for identifying planting needs.
* A lightweight Streamlit web application is appropriate for demonstrating these insights.

## Potential Benefits

* Urban planners can quickly identify underserved areas.
* Community organizations can advocate for greening in their neighbourhoods.
* Citizens gain an accessible way to explore how their neighbourhood compares.
* Academics/students gain a replicable case study of applied data analytics for urban sustainability.

# Proposed Research Project

## Objectives

1. Collect and preprocess Vancouver’s Public Trees dataset and Local Area Boundary data.
2. Build an interactive Streamlit dashboard with two modes:
   * Explore Trees: Explore individual trees and summary charts per neighbourhood.
   * Plan Planting: Show city-wide tree density and diversity, compute planting priorities, and rank neighbourhoods.
3. Calculate metrics for:
   * Tree density (trees per km²).
   * Species diversity (Shannon index).
4. Provide visual outputs:
   * A choropleth map of planting priorities.
   * A ranked table of neighbourhoods most in need of trees.

## Justification

The chosen methodology is supported by both urban forestry literature and best practices in decision analysis. Tree density (trees per km²) is a standard measure of canopy coverage and has been widely used to evaluate urban greening equity. Species diversity, commonly measured using the Shannon index, reflects ecological resilience and has been recommended as a key factor in sustainable urban forest management. Combining these indicators into a composite score aligns with multi-criteria decision analysis (MCDA), which is a well-established framework in geographic information systems for integrating multiple factors into a single decision metric. By implementing this analysis in a Streamlit dashboard, the project also applies data visualization and software development skills gained in coursework, ensuring the results are both scientifically grounded and practically accessible to stakeholders.

## Data Sources

* Public Trees dataset (City of Vancouver Open Data Portal)
  + Link: https://opendata.vancouver.ca/explore/dataset/public-trees
  + Sample size: 4285
* Local Area Boundary dataset (GeoJSON) (City of Vancouver Open Data Portal)
  + Link: https://opendata.vancouver.ca/explore/dataset/local-area-boundary
  + Sample size: 12

## Data Analytics

* Preprocessing: Clean missing species names, standardize coordinates.
* Spatial join: Assign each tree to its corresponding neighbourhood polygon.
* Metrics:
  + Tree density = total trees ÷ neighbourhood area (km²).
  + Diversity = Shannon index across species.
* Composite score: In later project phases, I will develop and test a Planting Priority Score (PPS) that combines density and diversity into a single measure of planting need. The exact formula and weights will be refined through experimentation and review of related literature, ensuring it is both academically grounded and practically useful.

## Technology Stack

* Language: Python
* Libraries: Pandas, GeoPandas, NumPy, Folium, Altair, Streamlit
* Interface: Streamlit web app (runs in a browser)
* Data storage: Local CSV and GeoJSON files

## Expected Results

* A functional Streamlit app with:
  + Explore Trees Tab: Interactive point map of trees, species distributions, diameter/age charts.
  + Plan Planting Tab: Choropleth map of planting priorities, ranked list of neighbourhoods.
* Research insights: A clear ranking of neighbourhoods most in need of greening, based on tree density and diversity.

# Project Planning and Timeline

## Detailed Table

| **Tasks** | **Date Range** | **Milestones** | **Deliverables** |
| --- | --- | --- | --- |
| **Proposal Phase** | Sept 6 – Sept 17, 2025 | Brainstorm project ideas, review datasets, draft problem statement & objectives, prepare methodology, timeline, and work log. | Final proposal submitted |
| **Data Collection & Preprocessing** | Sept 18 – Oct 2, 2025 | Collect datasets from Vancouver Open Data, clean missing species names, standardize coordinates, preprocess neighbourhood boundaries. | Cleaned CSV and GeoJSON datasets. |
| **Exploratory Data Analysis** | Oct 3 – Oct 10, 2025 | Conduct descriptive statistics (species counts, planting years, diameters), produce initial maps and charts. | EDA summary visualizations. |
| **Dashboard – Explore Tab** | Oct 11 – Oct 19, 2025 | Build Streamlit Explore tab with interactive maps, filters, spotlight feature, and charts. | Prototype dashboard (Explore tab). |
| **Midterm Report & Demo** | Oct 20 – Oct 25, 2025 | Prepare midterm report, conduct demo of Explore tab. | Midterm report and demo submission. |
| **Dashboard – Plan Planting Tab** | Oct 26 – Nov 5, 2025 | Implement choropleth maps for density/diversity, integrate neighbourhood boundaries, draft priority score logic. | Draft Plan Planting tab. |
| **Priority Score Development** | Nov 6 – Nov 12, 2025 | Refine Planting Priority Score (PPS), add adjustable weighting controls to dashboard. | PPS computation integrated into app. |
| **Testing & Usability Improvements** | Nov 13 – Nov 20, 2025 | Debug issues, improve filters and sidebar, enhance UI and tooltips. | Refined dashboard. |
| **Result Evaluation** | Nov 21 – Nov 28, 2025 | Evaluate results, rank neighbourhoods by PPS, document insights. | Ranked list of priority neighbourhoods. |
| **Final Report Writing** | Nov 29 – Dec 7, 2025 | Draft and finalize final report (methods, results, discussion). | Completed final report. |
| **Final Defense Preparation** | Dec 8 – Dec 15, 2025 | Prepare slides, rehearse demo, polish app visuals. | Final defense presentation and working dashboard. |

## Gantt Chart

A graph with blue rectangles

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# Project Contract

As the sole project developer, I commit to:

* Delivering a functional web application as outlined.
* Writing all reports (proposal, midterm, final).
* Upholding academic integrity by citing all sources and datasets.

# Work Log Table

| **Date** | **Hours** | **Description of work done** |
| --- | --- | --- |
| Sept 6, 2025 | 1.5 | Reviewed project requirements and brainstormed initial ideas. |
| Sept 9, 2025 | 2 | Explored Vancouver Open Data portal. Identified Public Trees dataset and Local Area Boundaries as suitable sources. |
| Sept 12, 2025 | 2 | Conducted background research on urban greening benefits and Vancouver’s Urban Forest Strategy. Drafted background section. |
| Sept 15, 2025 | 2.5 | Developed objectives and methodology outline. Created project timeline and Gantt chart. |
| Sept 17, 2025 | 3 | Proofread and finalized the proposal. Completed references and formatted work log. Submitted proposal. |

# Closing and References

## Closing

This project will deliver a feasible, interactive dashboard that addresses a real urban sustainability challenge. By combining Vancouver’s open datasets with modern data analytics techniques, it will identify priority areas for tree planting based on tree density and biodiversity. The Urban Greening Planner not only demonstrates applied analytics but also provides practical insights that could support planners and community groups in making Vancouver greener and more equitable.

## Acknowledgement

I would like to acknowledge the City of Vancouver for providing open data resources that make this project possible.

## References

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