

# Design Solutions for Sustainable Streets & Roadsides



a presentation to



August 2, 2017



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# Design Solutions for Sustainable Streets & Roadsides

[www.unri.org/research-documents](http://www.unri.org/research-documents)



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# Topics for today's presentation

- Tree values
- Design as a process
- Trees as design and landscape elements
- Constraints in urbanized landscapes
- Streetscape scenarios
- A few solutions



# Urban design to encourage tree canopy



- Trees often grow poorly in urban areas for a variety of reasons.
- Poor design is often one of those reasons.



# Few people want cities without trees





# Few people want cities without trees



# Few people want cities without trees





# Few people want cities without trees





Few people want cities without trees



# Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





# Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees





Few people want cities without trees



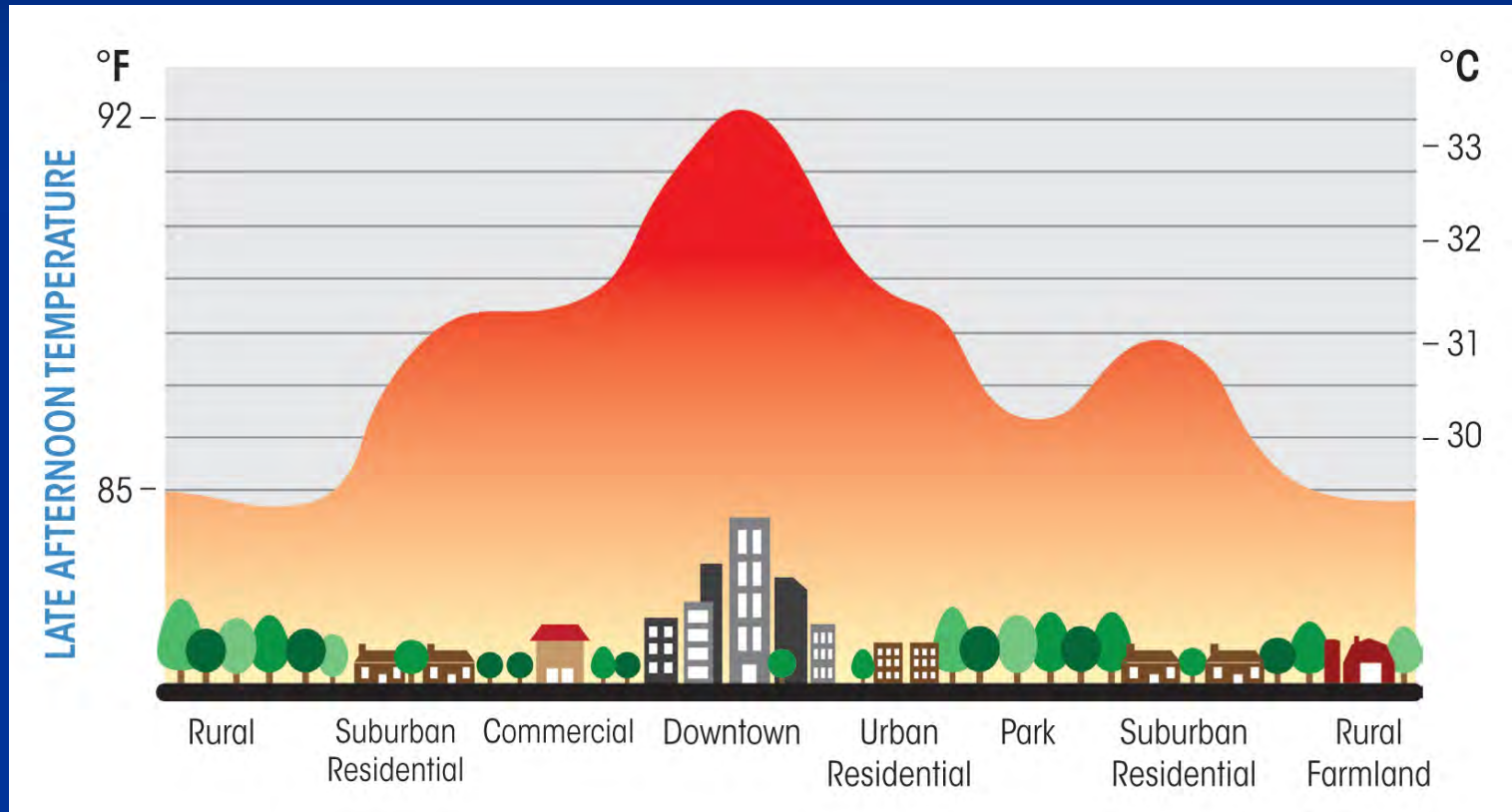
# Few people want cities without trees

- A city without trees is hotter in summer, receives less rainfall, has greater runoff following storms, has fewer shoppers, and is not inviting

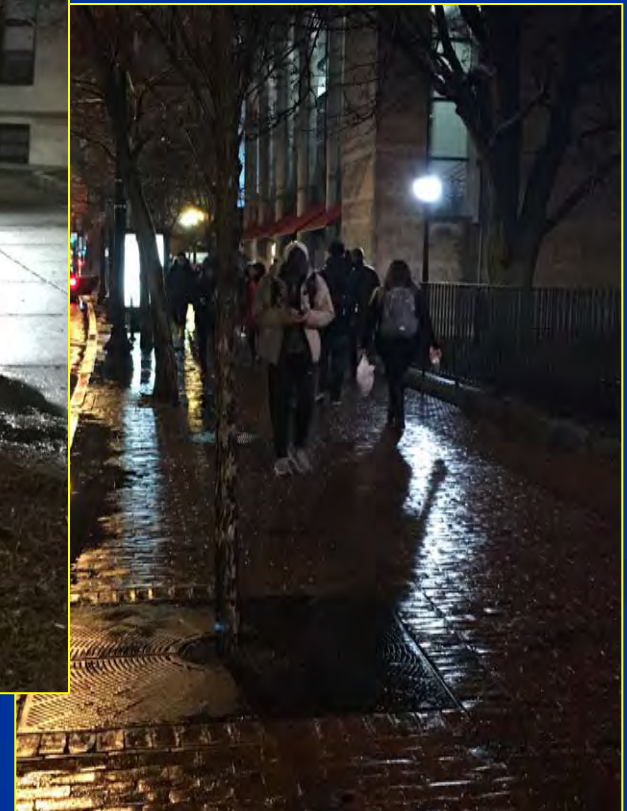




# Urban Heat Island



# Impact of Stormwater & Impervious Area

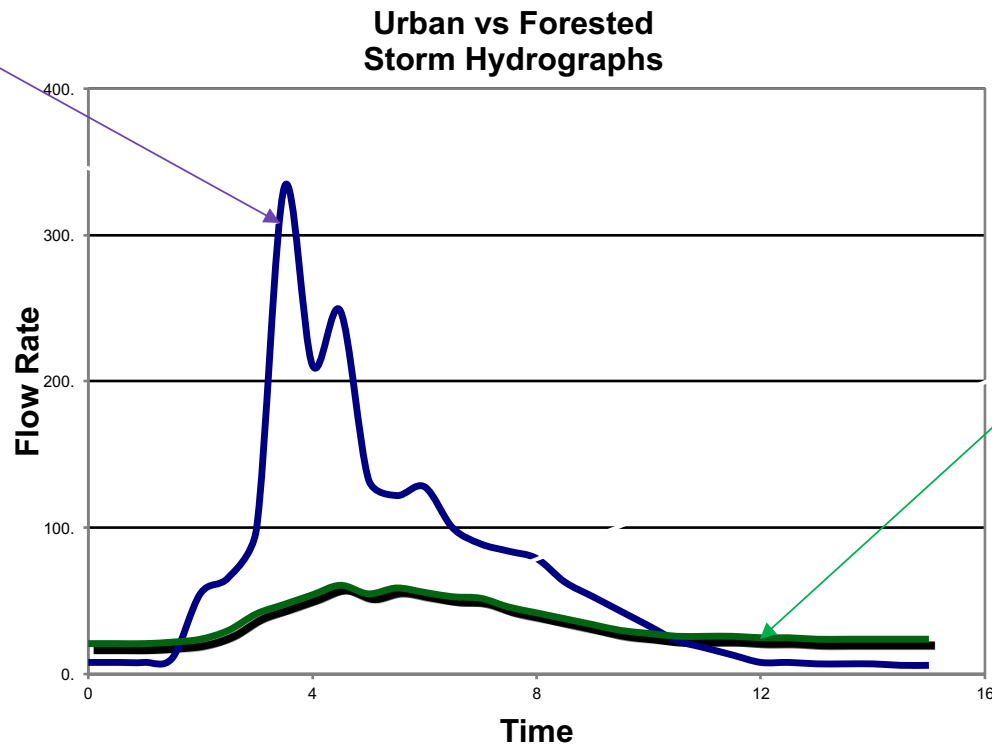




# The Urban Storm Hydrograph

Greater Peaks & Volume

Urban



Forested



# Poor design leads to failure



- Trees struggle unless spaces are designed appropriately
- When lots of money is thrown at tree projects without guidance from knowledgeable professionals, waste occurs and no one wins



# Poor design leads to failure





# Poor design leads to failure



# Poor design leads to failure





# Good design leads to success



- Trees thrive when good designs are executed properly
- Healthy trees increase property value, intercept air pollutants, buffer temperatures, reduce wind speed, cool the city, reduce runoff from storms, encourage people to visit and spend money at shops, and create a more inviting community





# Good design leads to success



# Good design leads to success





# Good design leads to success



# Good design leads to success





# Good design leads to success



Good design leads to increased  
value - economic & environmental






# Good design leads to increased value - economic & environmental

Select Language

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Home | Search | Download i-Tree Desktop Suite | Create Account | Login




Tools for Assessing and Managing  
Forests & Community Trees

I-Tree Tools

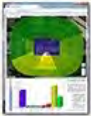
News

Resources


Support



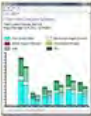
**Landscape**  
(web app)  
Regional analyses of tree benefits in minutes for cities, counties, and more.




**Design**  
(web app)  
Parcel level analysis for current and future tree benefits.



**Eco**  
(desktop app)  
Our flagship i-Tree tool. Structure, Environmental Effects, & Value.



**Hydro**  
(desktop app)  
Explore the effects of tree canopy on water quantity and quality.



**Canopy**  
(web app)  
Quickly estimate tree canopy and benefits using aerial maps.

## What is i-Tree?

- Quantify structure, risk & environmental services of trees
- Advocacy and management tools for community trees
- Built upon peer-reviewed USFS science
- Free and easy to use

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their forest management and advocacy efforts by quantifying the structure of trees and forests, and the environmental services that trees provide.

Since the initial release of the i-Tree Tools in August 2006, thousands of communities, non-profit organizations, consultants, volunteers and students have used i-Tree to report on individual trees, parcels, neighborhoods, cities, and even entire states. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link forest management activities with environmental quality and community livability. Whether your interest is a single tree or an entire forest, i-Tree provides baseline data that you can use to demonstrate value and set priorities for more effective decision-making.

i-Tree Tools are in the public domain and are freely accessible. We invite you to explore this site to learn more about how i-Tree can make a difference in your community or forest.

Sustainable Urban Forest  
Step-by-Step Approach  
A flexible roadmap for  
Sustainable UF planning >>

Improve i-Tree Tools,  
Resources and services  
The Customer Satisfaction  
Survey >>

Learn how to use i-Tree Tools  
in our Video Learning  
Resources  
Learn more >>

The 2017 Suite version 6.1.18  
Now available  
Learn more >>  
Download >>

Learn about i-Tree in upcoming  
and online workshops  
Topics and dates >>

i-Tree Reports applying i-  
Eco, Design, Canopy &  
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Tree  
Visit



# Good design leads to increased value - economic & environmental





# Good design leads to increased value

## - economic & environmental

### Tree Facts

Serving Size: 14 in DBH (35.6 cm)  
Species: Pin Oak, *Quercus palustris*

Amount Per Serving

**Carbon sequestered 259 lbs**

**avoided 257 lbs**

% Annual Value\*

**Total Carbon 537 lbs**

**O3 \$1.96**

**VOC(Volatile Organic Compounds) \$0.93**

**NO2(Deposited) \$0.85**

**NO2(Avoided) \$3.36**

**SO2(Deposited) \$0.25**

**SO2(Avoided) \$1.40**

**PM10(Deposited) \$1.77**

**PM10(Avoided) \$0.39**

Conserved Kilowatt/hours 96 Kwh

Reduced oil/natural gas consumption 28 therm(s)

**Stormwater intercepted 1,527 gallons**

Property value increase \$103.00 Natural Gas \$39.93

**Stormwater \$12.21**

**Electricity \$12.92**

\*It should be noted that trees themselves emit biogenic volatile organic compounds (BVOCs) which can contribute to ground-level ozone production. This may negate the positive impact the tree has on ozone mitigation for some high emitting species (e.g. Willow Oak or Sweetgum). However, the sum total of the tree's environmental benefits always trumps this negative.

Source:

[www.treesaregood.com/documents/FactSheet\\_Palustris\\_Oak.pdf](http://www.treesaregood.com/documents/FactSheet_Palustris_Oak.pdf)

USDA Forest Service's Center for Urban Forest Research

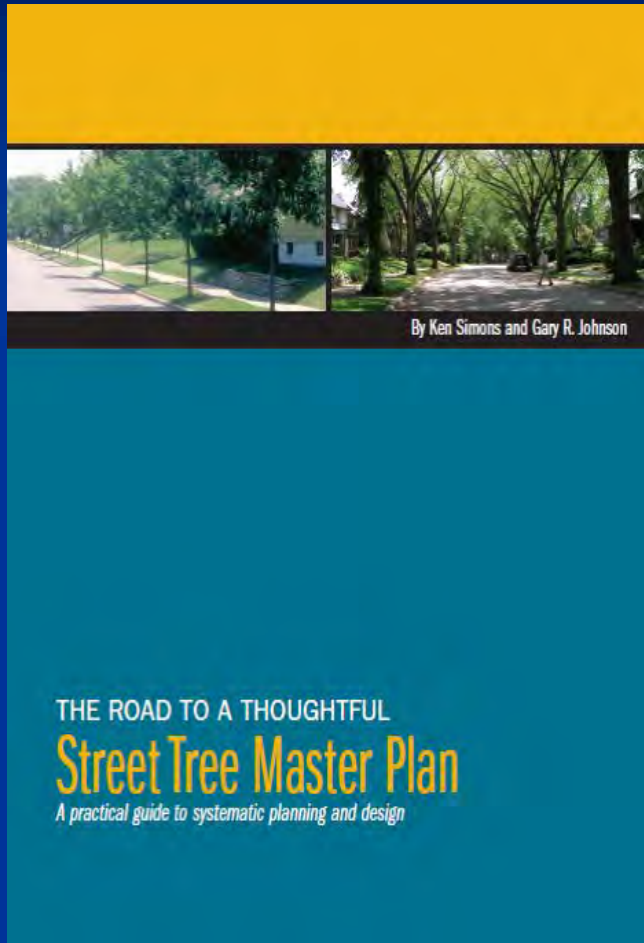
\* Tree Value CO2 SECT. <http://www.treesaregood.com>



Good design leads to increased value  
- economic & environmental







THE ROAD TO A THOUGHTFUL

# Street Tree Master Plan

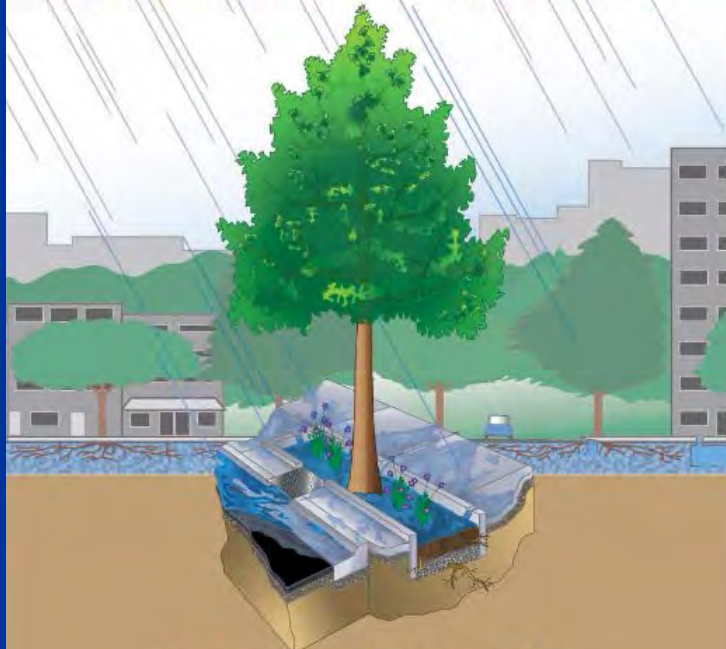
*A practical guide to systematic planning and design*

Ken Simons<sup>1</sup>  
and  
Gary R. Johnson<sup>2</sup>



United States  
Environmental Protection  
Agency

# STORMWATER to STREET TREES



Engineering Urban Forests for  
Stormwater Management

## Stormwater to

## Street Trees:

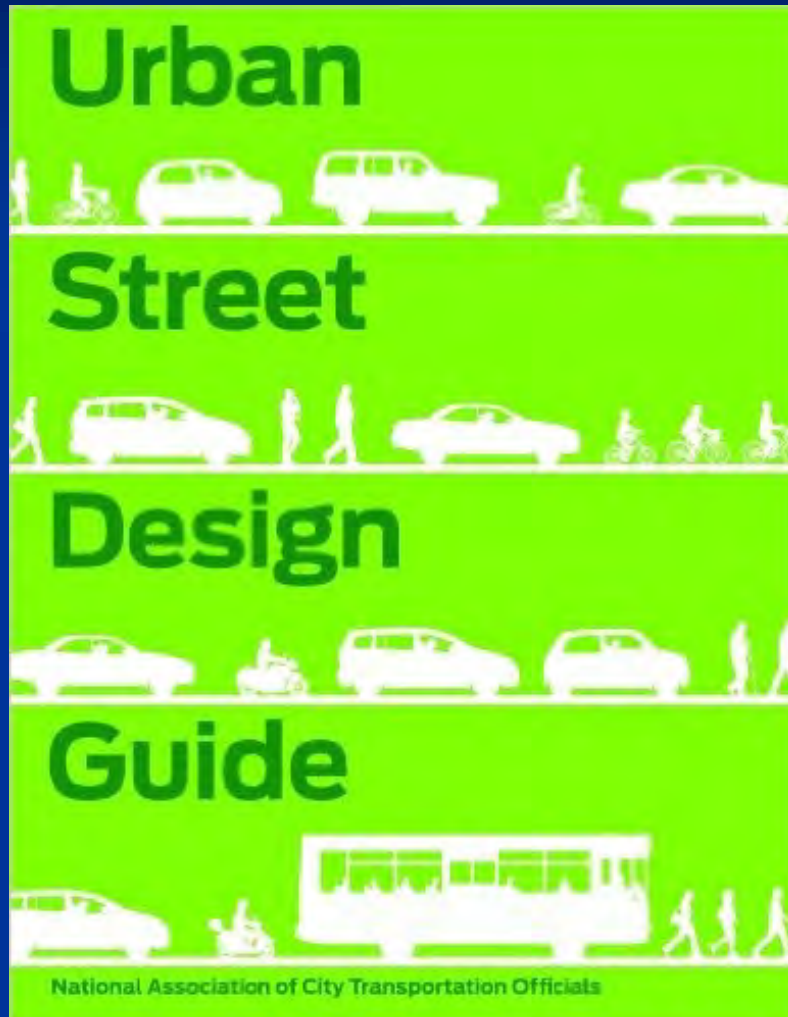
### Engineering Urban Forests for Stormwater Management

U.S. Environmental Protection Agency  
Office of Wetlands, Oceans and Watersheds  
Nonpoint Source Control Branch (4503T)  
1200 Pennsylvania Ave., NW  
Washington, DC 20460

September 2013

EPA 841-B-13-001







## Urban Street Design Guide

[PURCHASE GUIDE](#)[GUIDE NAVIGATION ▾](#)

Streets



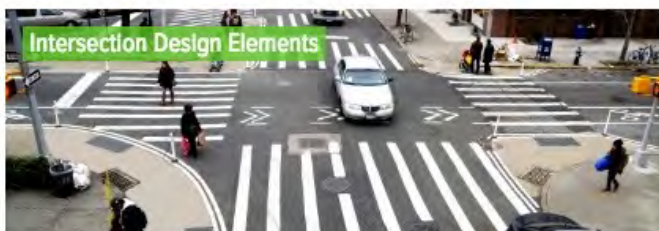
Street Design Elements



Interim Design Strategies



Intersections



Intersection Design Elements



Design Controls



# Good design must be realistic



# Good design must be realistic





# Good design must be realistic





# Good design must be realistic





# Good design is contextual



# Good design shapes the community





# Good design should be comprehensive

## Streetscape Detail Perspective

### Key Design Elements

Below is a list of key design features influencing the overall streetscape concepts.

- Create ADA compliant curb ramps by limiting slope to 8% max, 5' wide min., and include a strip of truncated dome detectable warning pavers at the base of the ramps.
- The pedestrian crosswalks will be delineated by brick stamped concrete paving. The color of the concrete should be brick red to resemble natural clay brick color.
- Redefine parking lots, business entries, and circulation will provide for a more fluid and safe travel of vehicular and pedestrian traffic.
- Planting strips along sidewalks will provide aesthetic appeal and soften to overall look of the streetscape.
- The proposed street lights are placed to provide sufficient lighting to key areas throughout the corridor, without overpowering the calm suburban feel that exists. The light standards will also help to create a visual and physical barrier between the roadway and pedestrian zone.
- Landscaped medians will be used at major pedestrian crosswalks to help designate the pedestrian crossings. Throughout the rest of the corridor a continuous turn lane will be used to allow for maximum vehicular access.



# Good design can provide vision





# Principles of Design

Unity

Balance

Transition

Proportion

Rhythm

Repetition

Simplicity



# Principles of Design

Unity

Balance

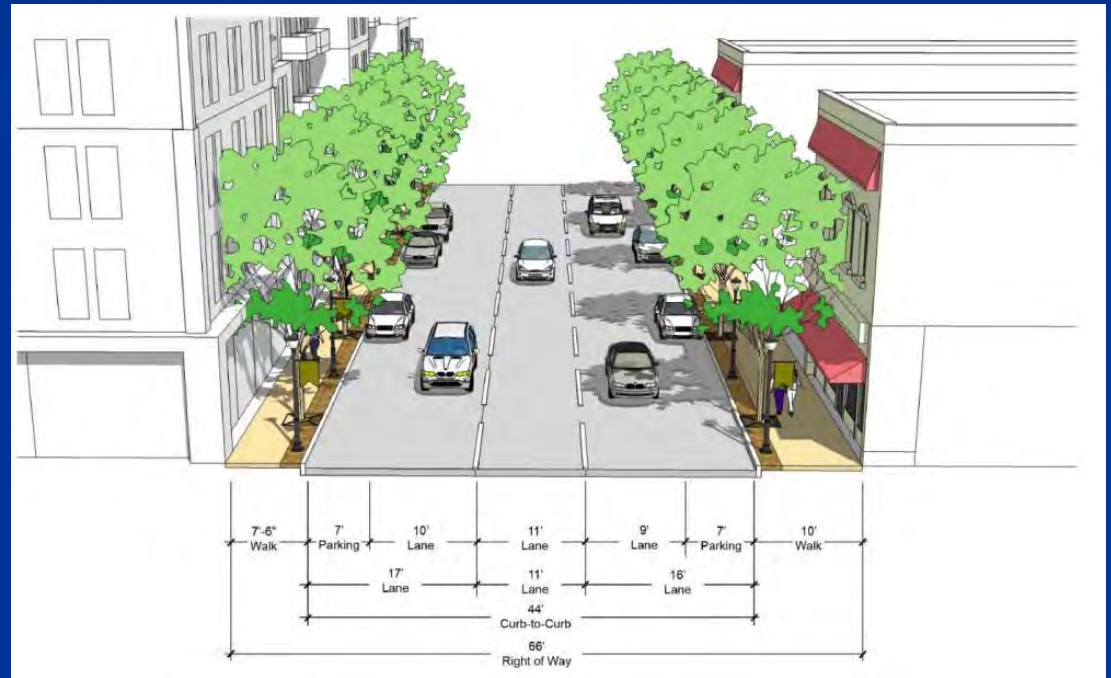
Transition

Proportion

Rhythm

Repetition

Simplicity





# Elements of Art

Color

Line

Form

Texture

Scale



# Elements of Art

Color

Line

Form

Texture

Scale





# Principles of Science

- Horticulture
  - Plant needs
  - Insect and diseases
  - Hardiness zones
  - Physiological Constraints
  
- Engineering
  - Materials
  - Methods
  - Soils and drainage
  - Irrigation systems



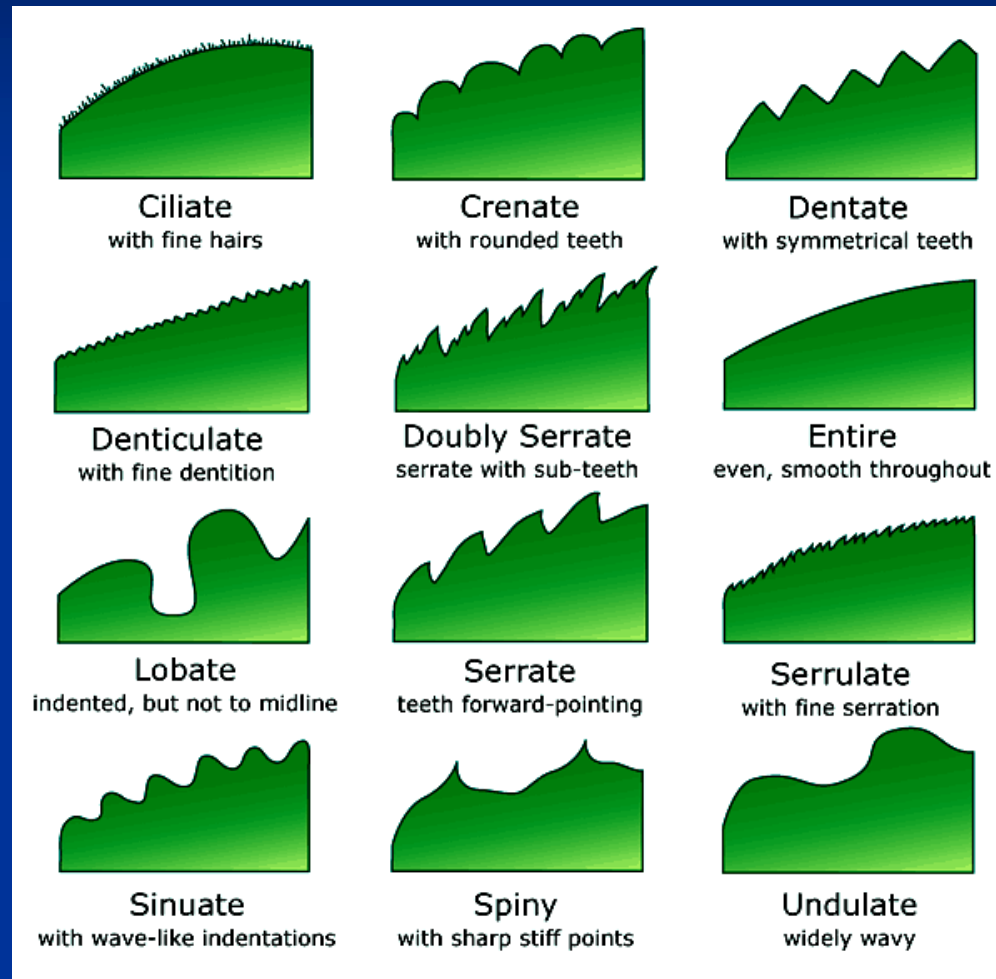


# Trees as Landscape Elements

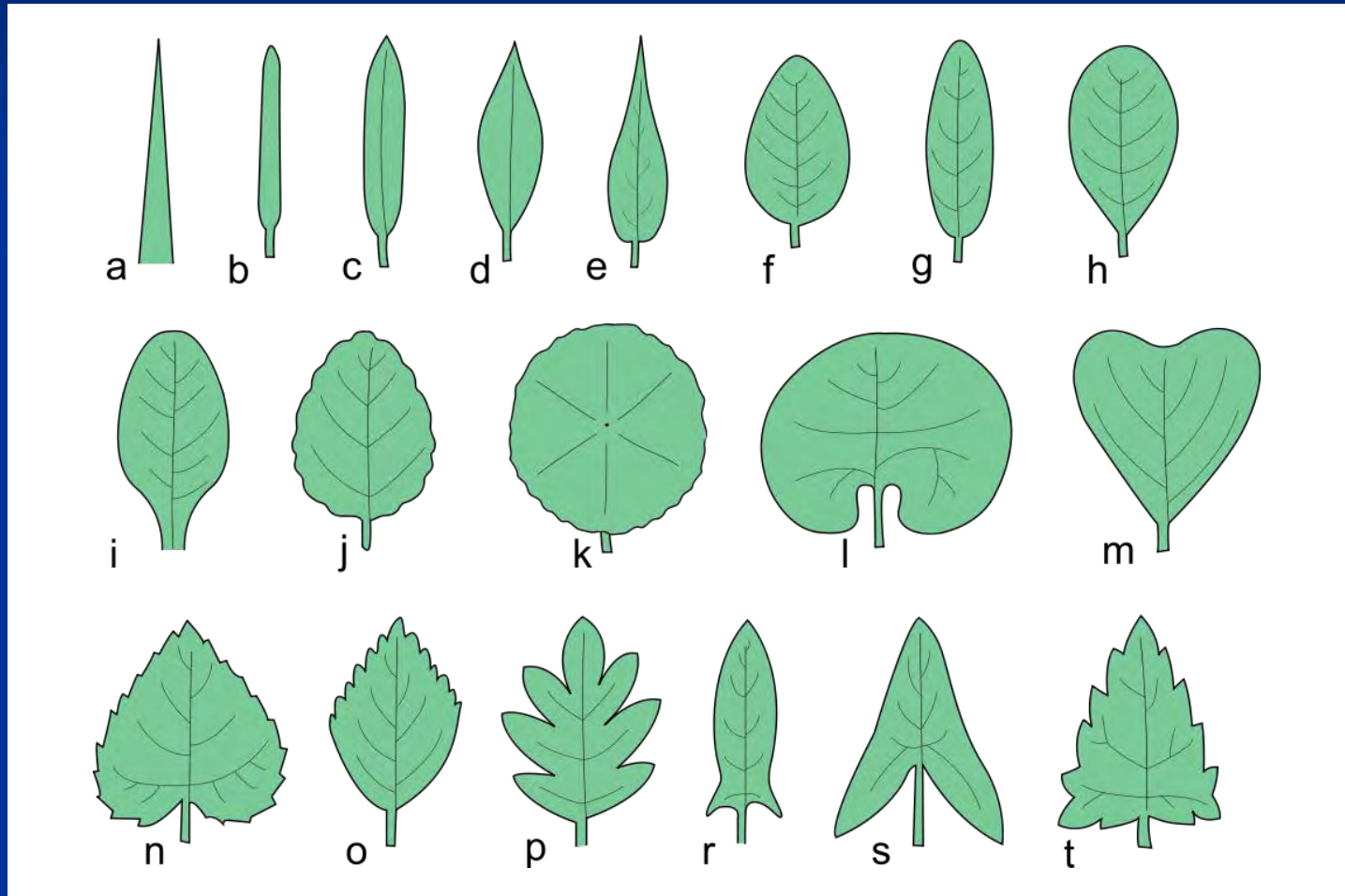




# Trees as Landscape Elements



# Trees as Landscape Elements





# Trees as Landscape Elements



Design Principles















# Trees as Landscape Elements



Constraints

# Trees as Landscape Elements



Constraints



# Trees as Landscape Elements



Constraints

# Trees as Landscape Elements



Constraints



# Trees as Landscape Elements



Constraints



# Trees as Landscape Elements



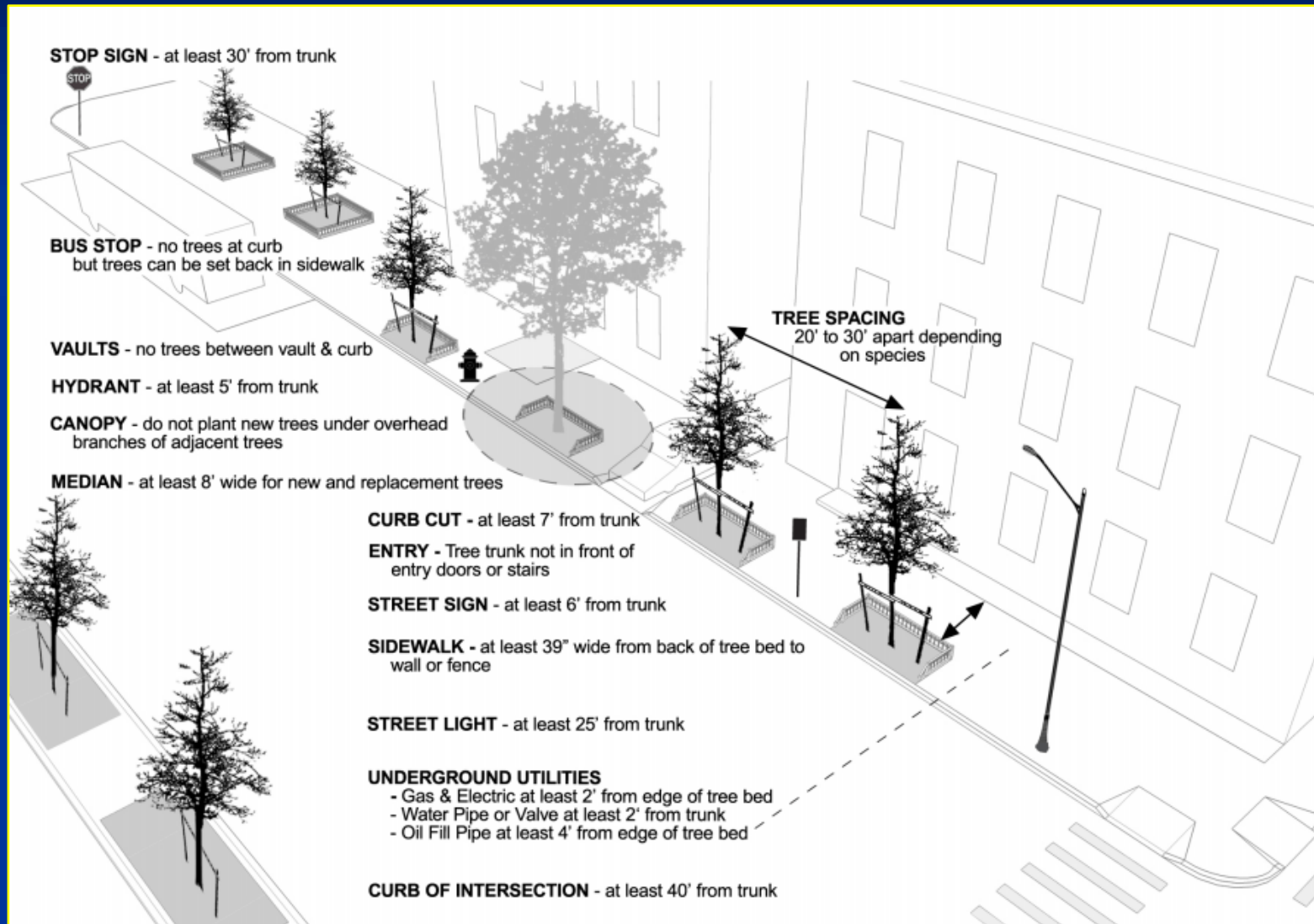


# Trees as Landscape Elements



Constraints

# Trees as Landscape Elements





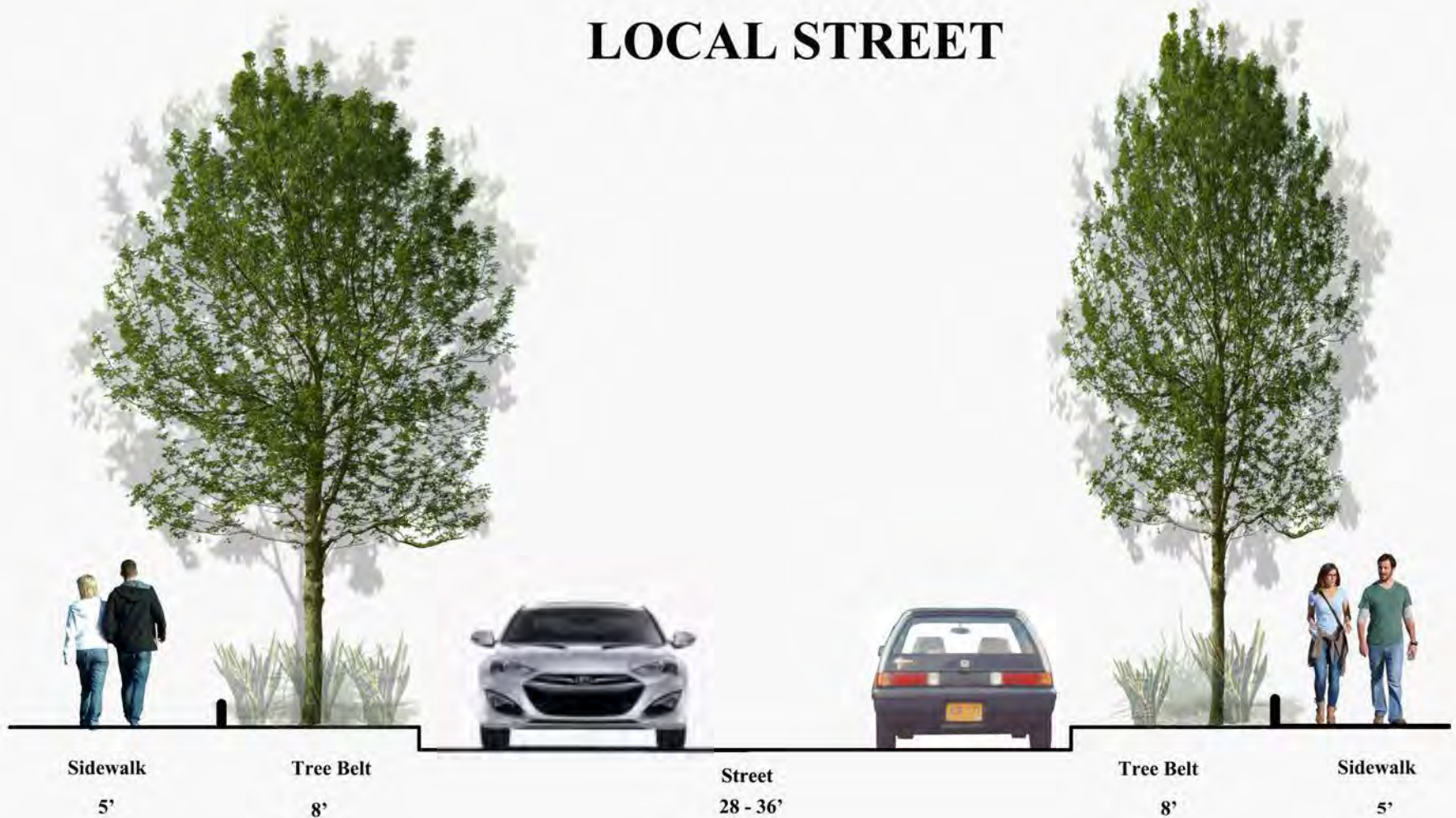
# Streetscape design scenarios

## LOCAL STREET



# Streetscape design scenarios

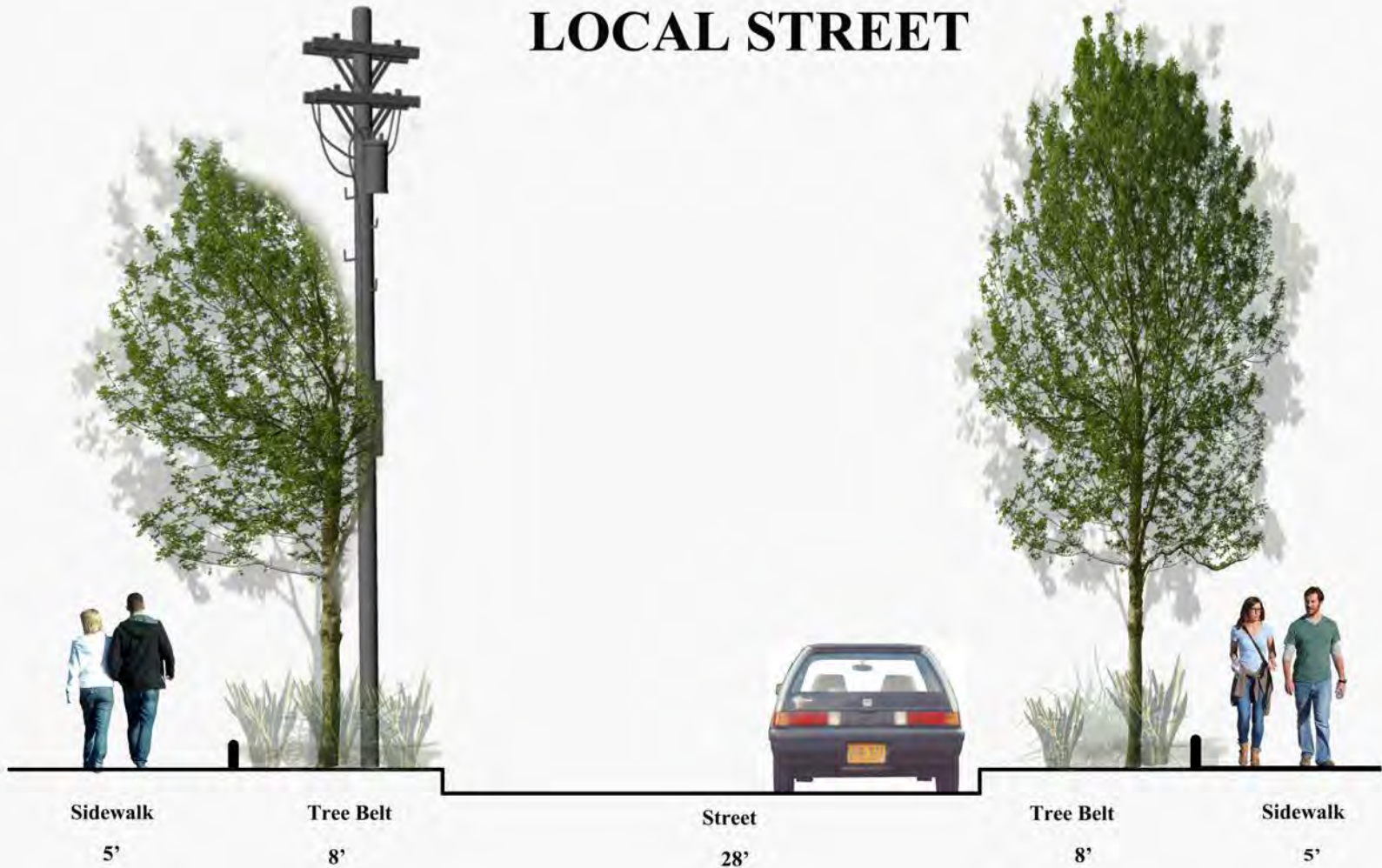
## LOCAL STREET





# Streetscape design scenarios

## LOCAL STREET



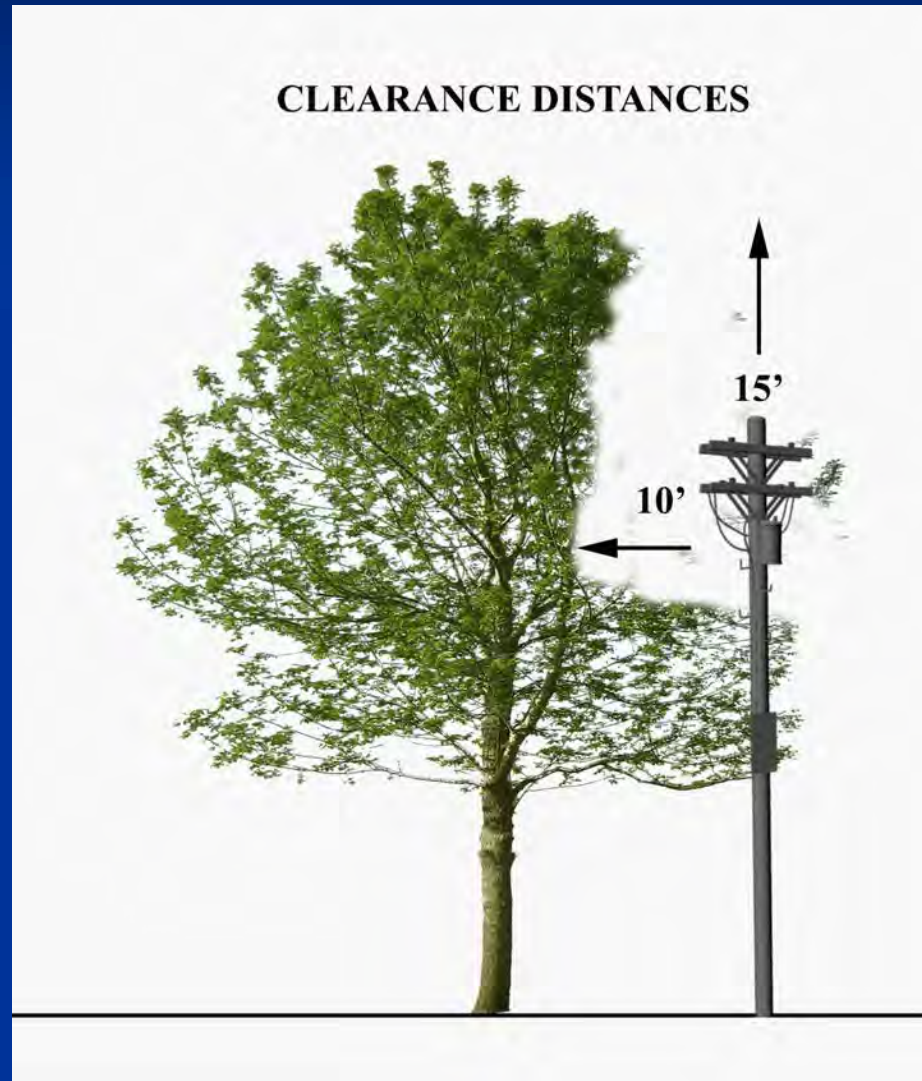
# Streetscape design scenarios

## LOCAL STREET

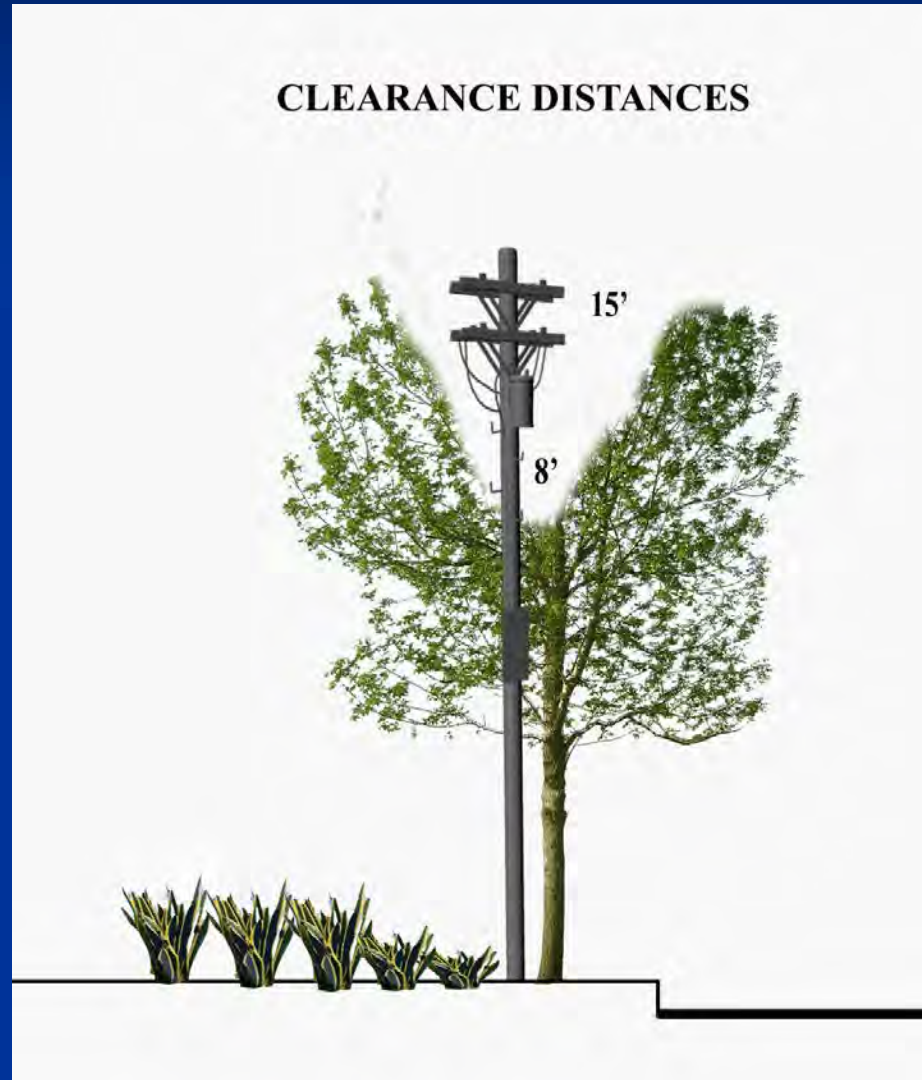




# Streetscape design considerations

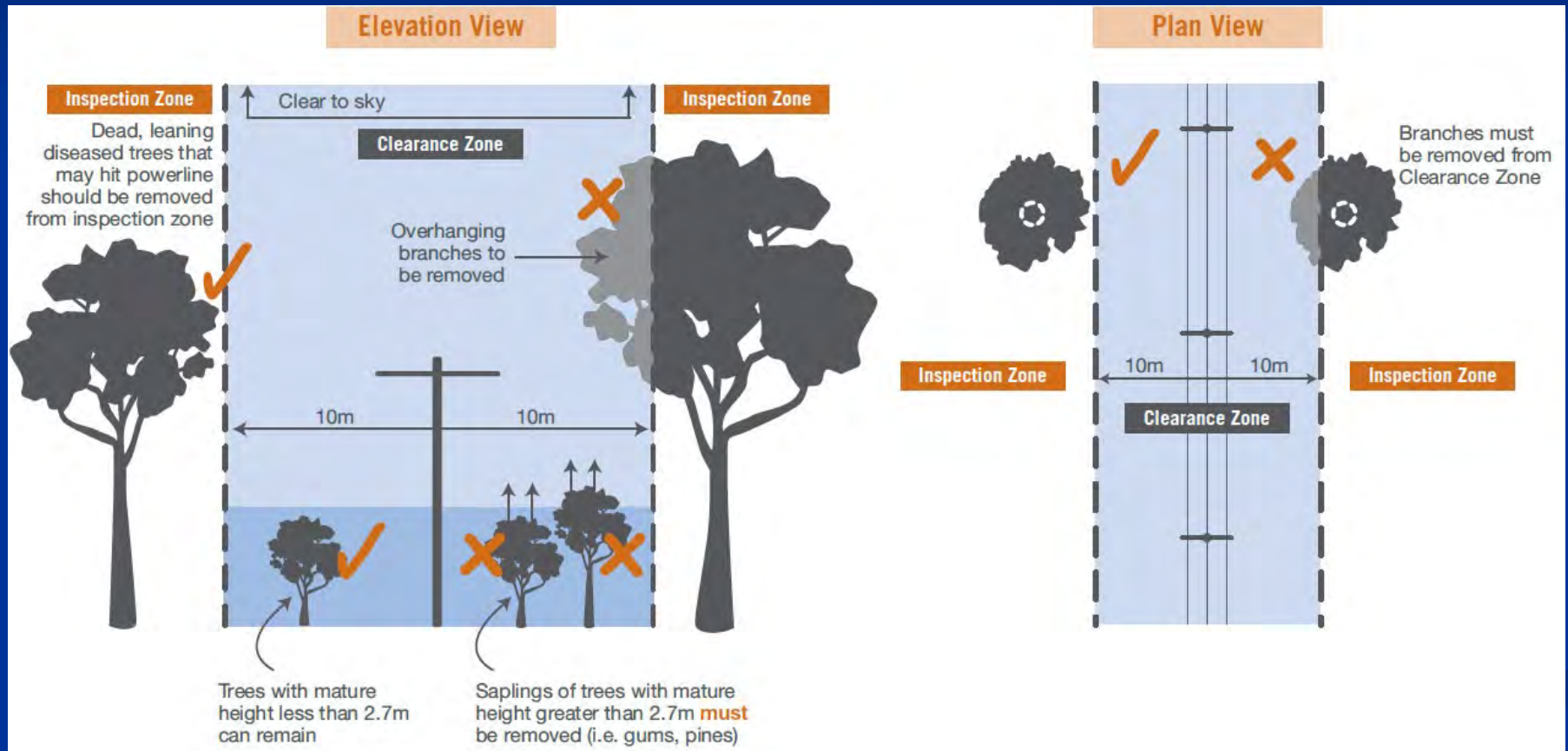


# Streetscape design considerations





# Streetscape design considerations



# Streetscape design considerations





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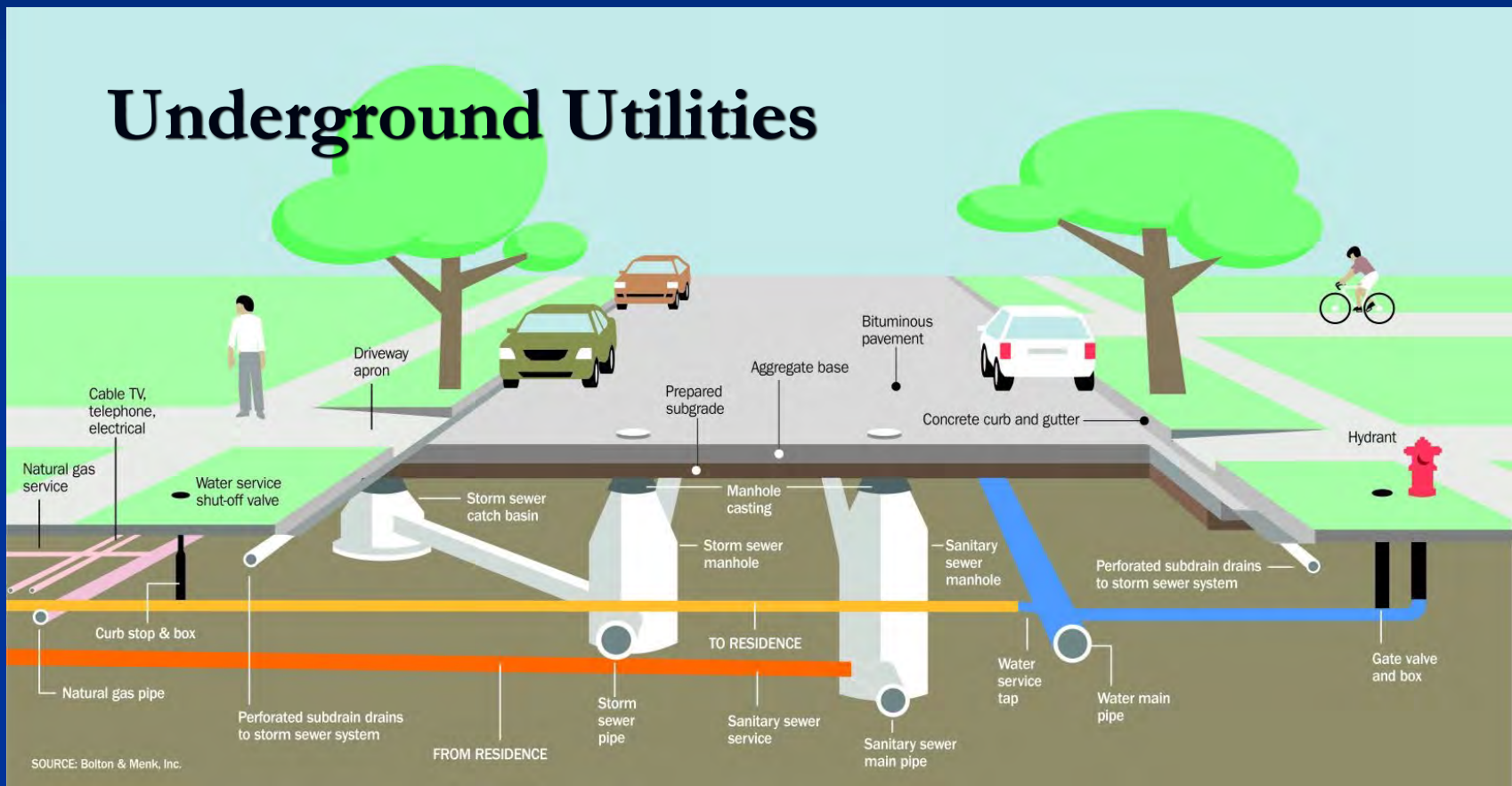




# Streetscape design considerations



# Streetscape design considerations





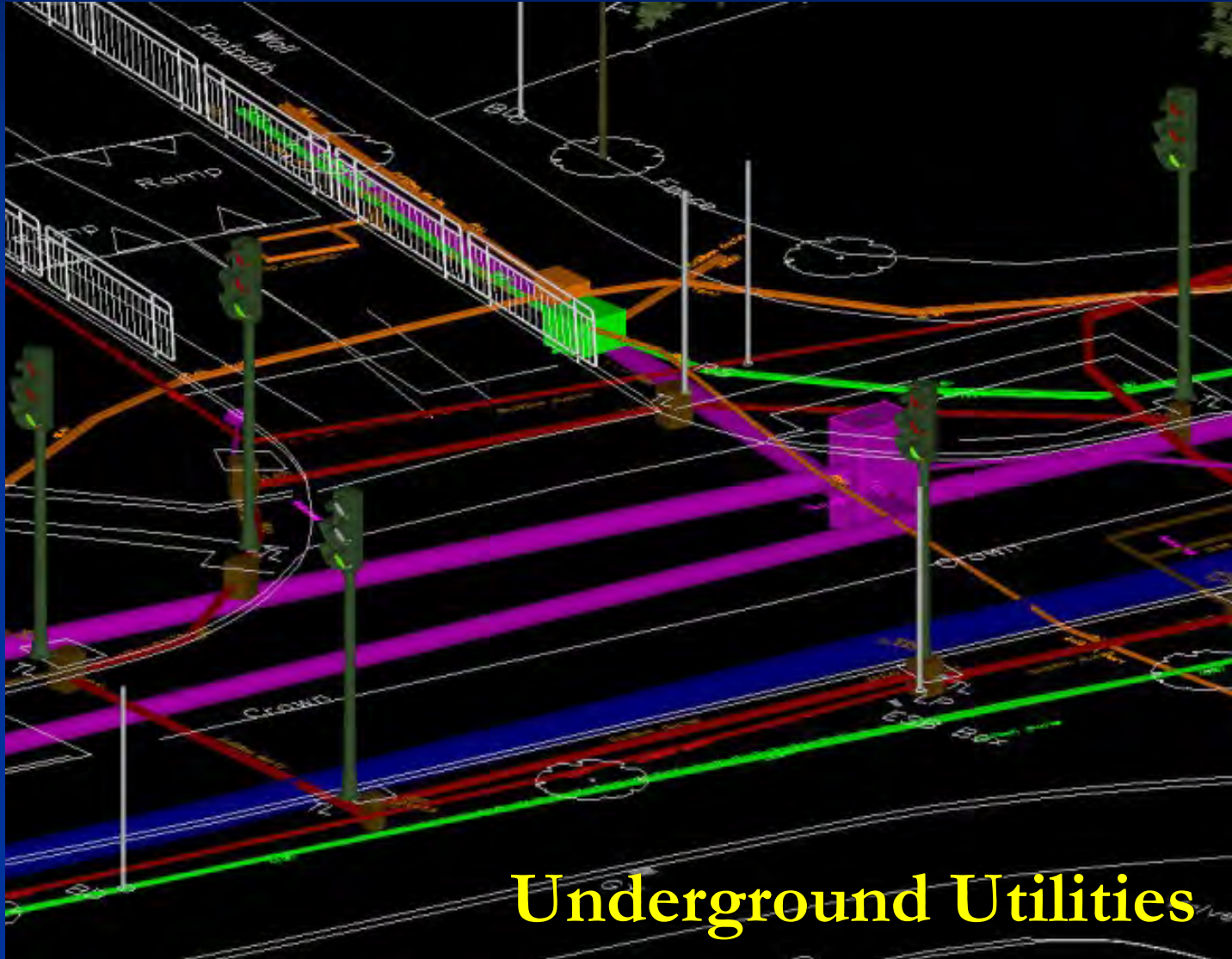
# Streetscape design considerations

## Underground Utilities





# Streetscape design considerations



**Underground Utilities**



# Streetscape design considerations





# Streetscape design considerations



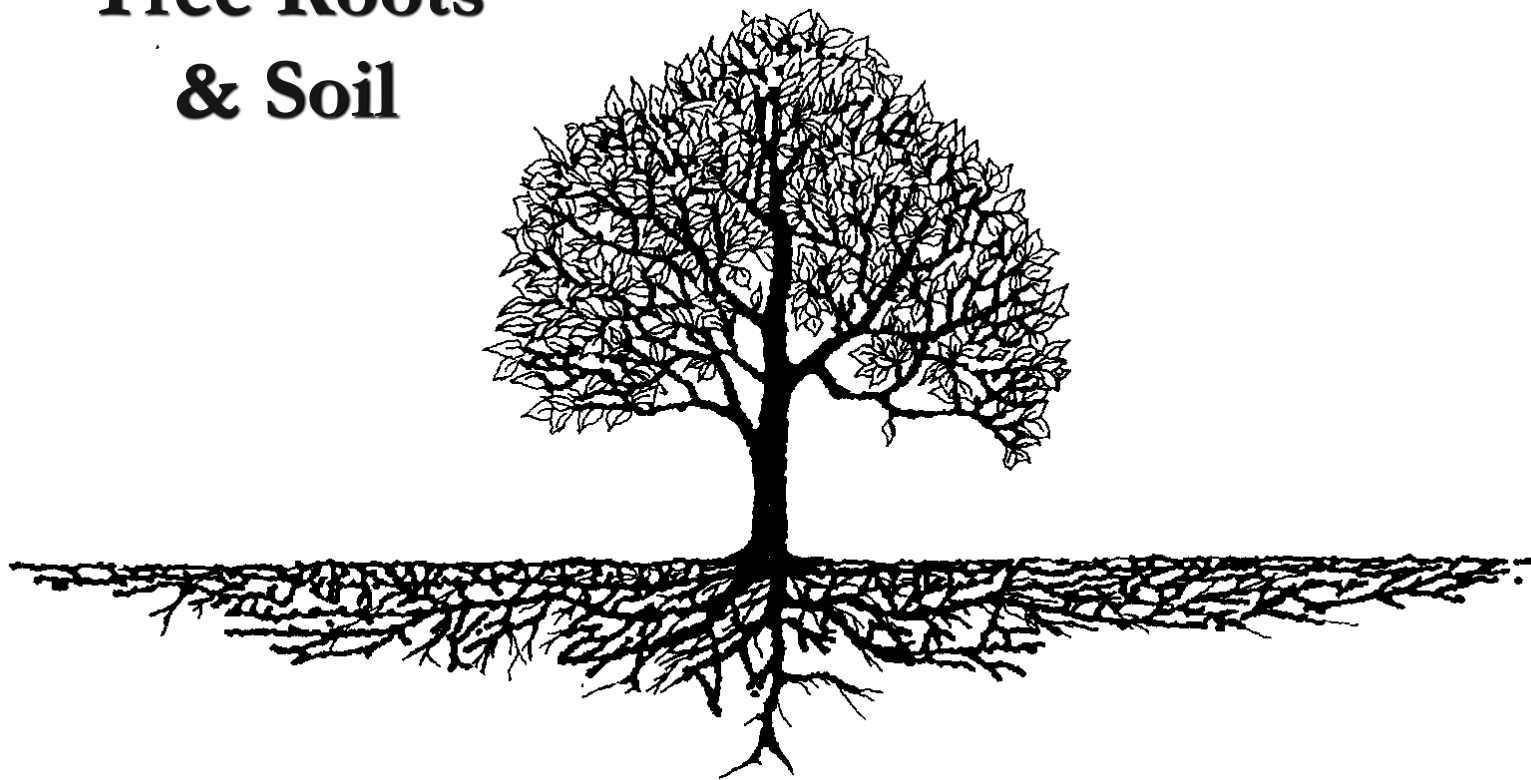


# Streetscape design considerations



# Streetscape design considerations

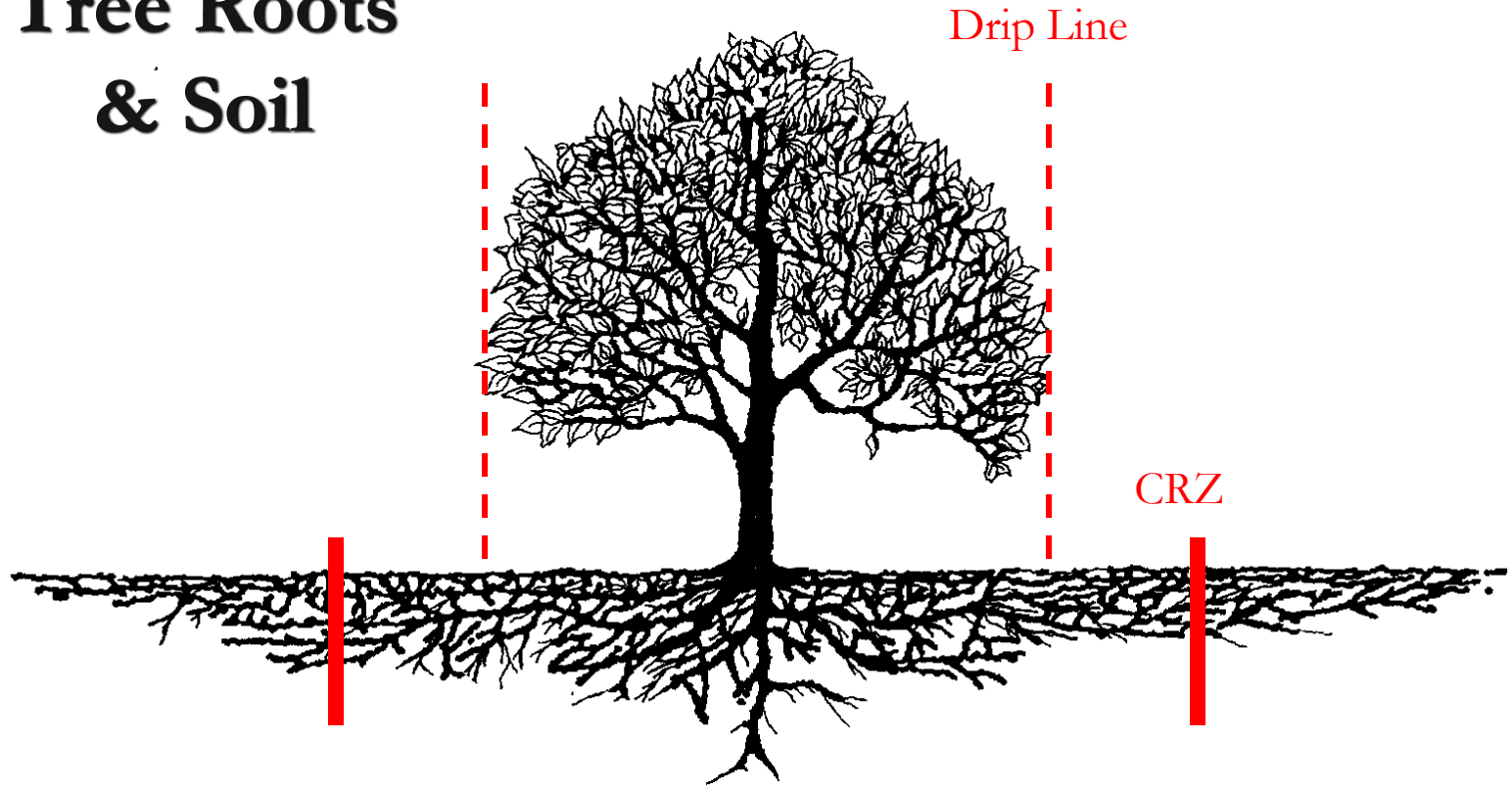
## **Tree Roots & Soil**



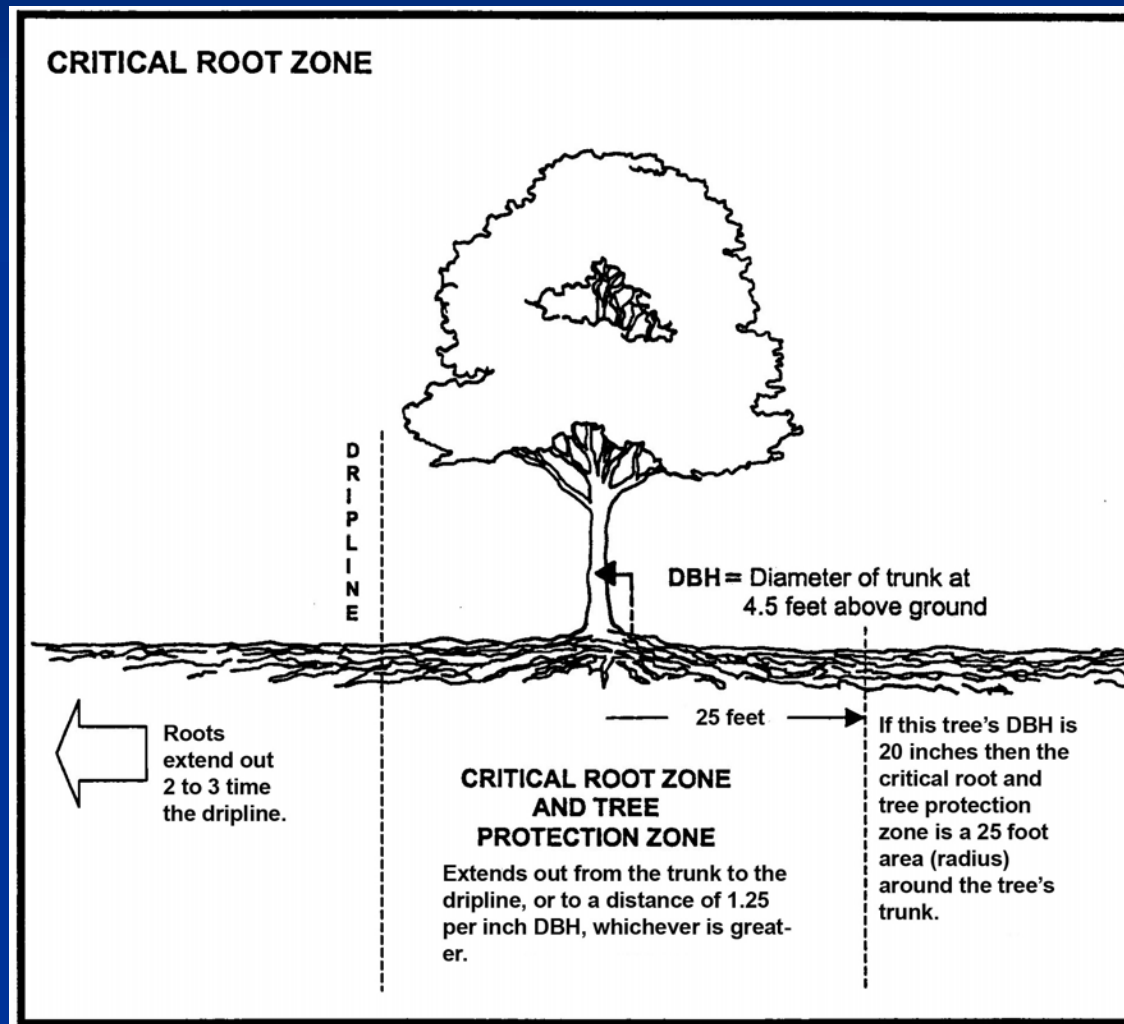


# Streetscape design considerations

## Tree Roots & Soil



# Streetscape design considerations





# Streetscape design considerations

## Soil Volume

estimated crown spread =  
10 feet diameter



**Soil Volume = 120 cubic feet**

estimated crown spread =  
21 feet diameter



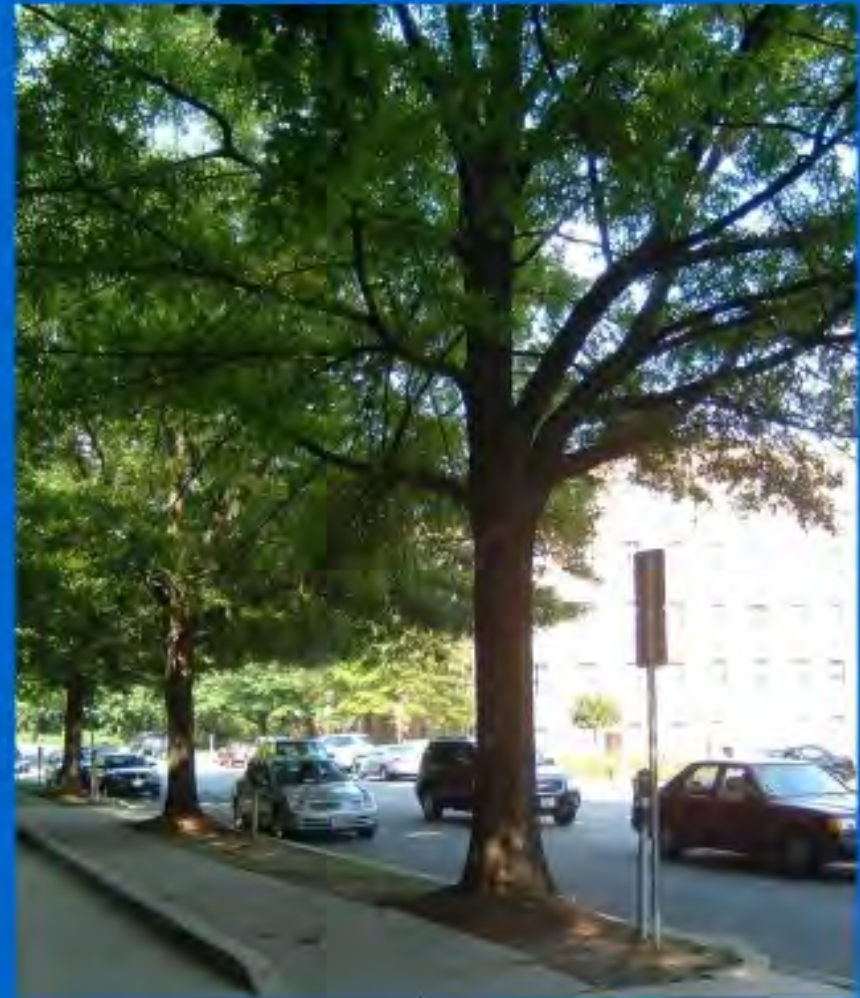
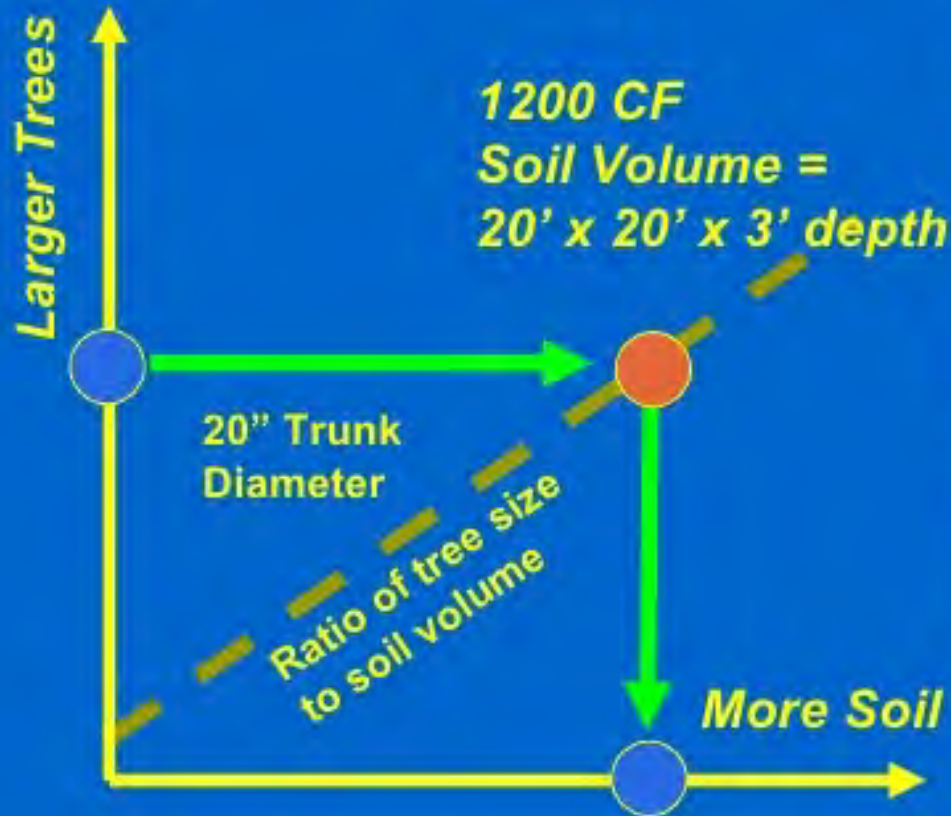
**Soil Volume = 500 cubic feet**

estimated crown spread =  
30 feet diameter



**Soil Volume = 1000 cubic feet**

# How Much Soil ?

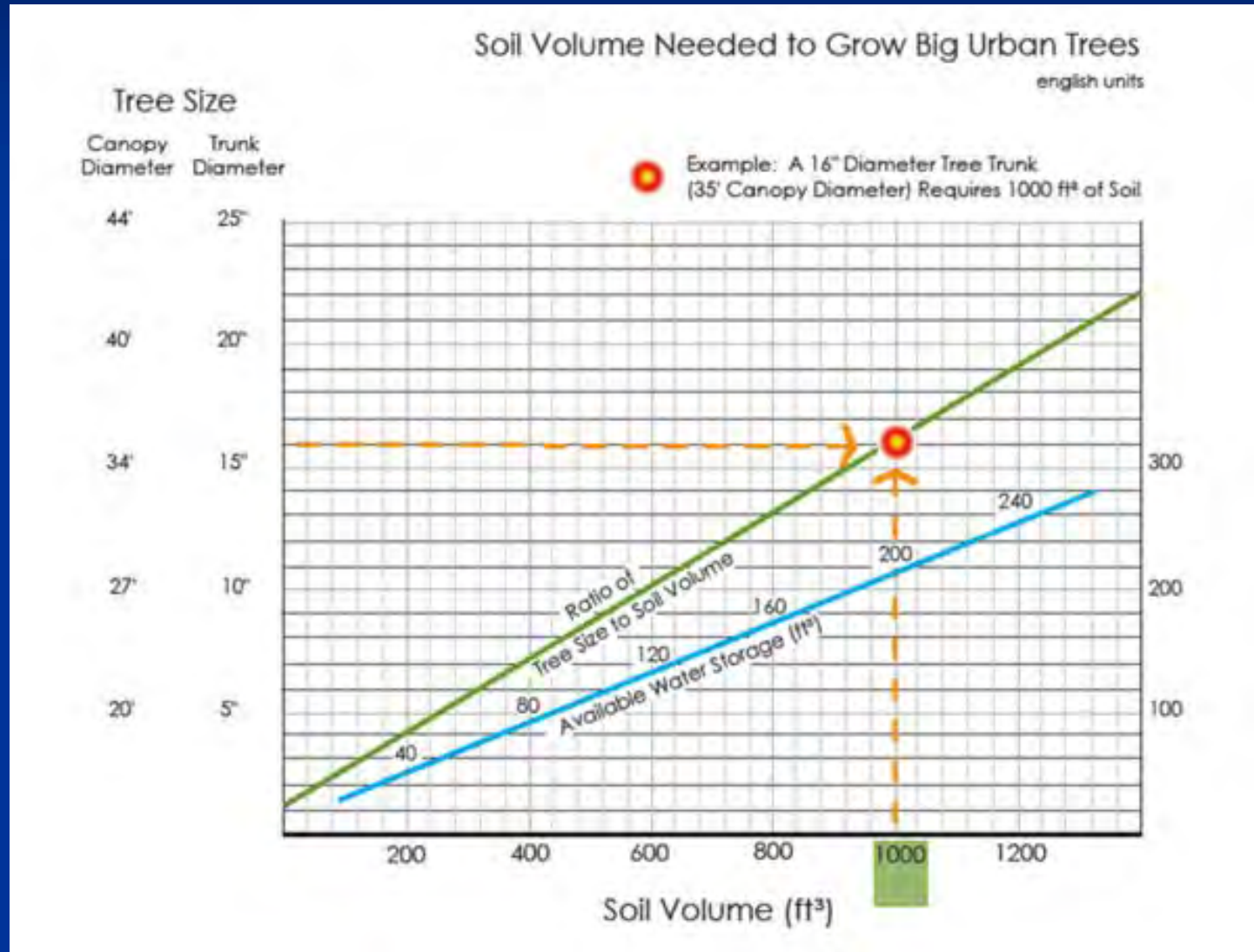


JAMES URBAN, FASLA, ISA

**20" Trunk Diameter Tree will require  
20' x 20' x 3' deep soil volume (min.).**



# Streetscape design considerations



# Streetscape design considerations

## COLLECTOR STREET





# Streetscape design considerations

## COLLECTOR STREET



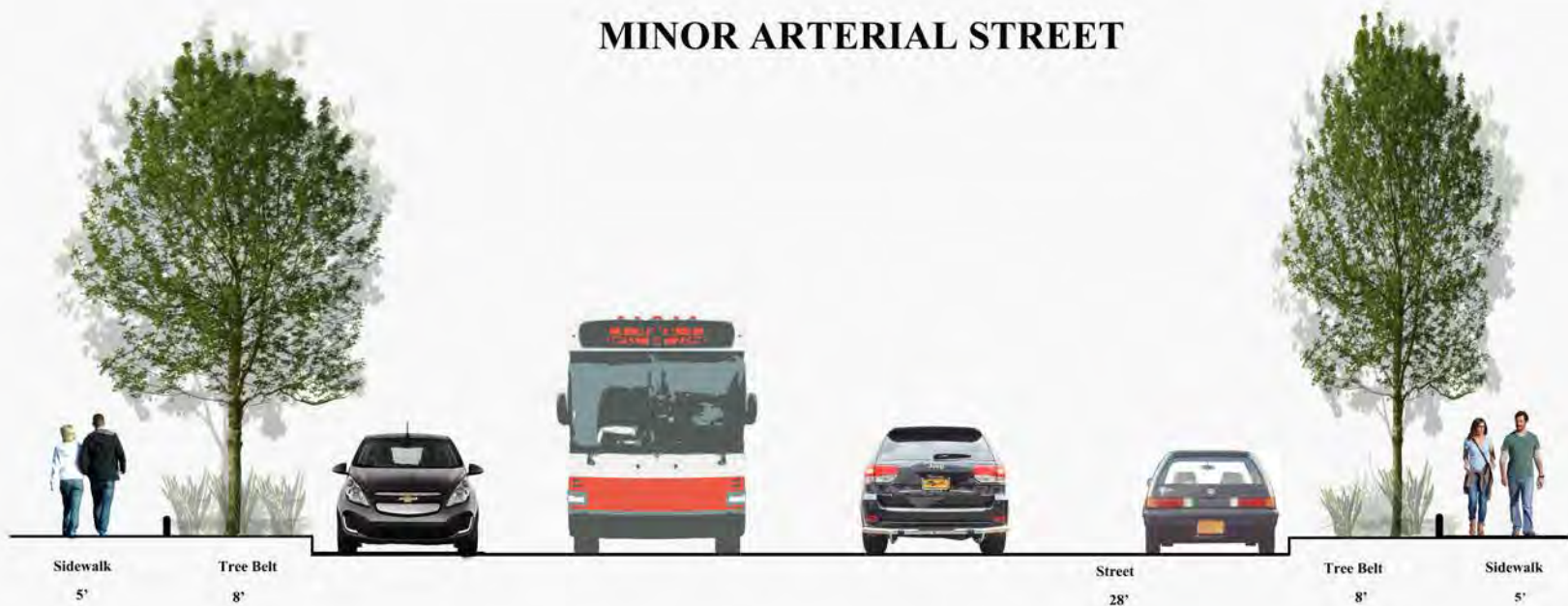
# Streetscape design considerations





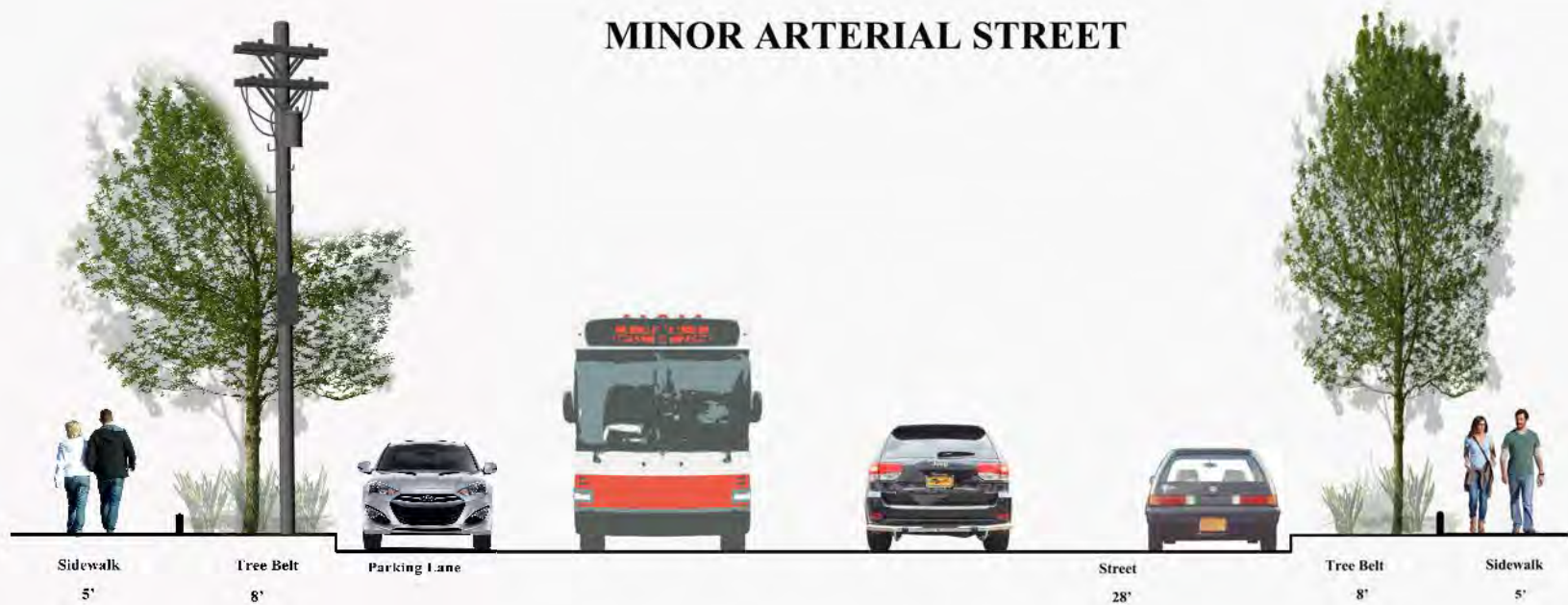
# Streetscape design considerations

## MINOR ARTERIAL STREET



# Streetscape design considerations

## MINOR ARTERIAL STREET





# Streetscape design considerations

## MAJOR ARTERIAL STREET



# Streetscape design considerations





# Consider These Alternatives

- Proper species selection, so that only trees that will not interfere with wires, building and other infrastructure.
- Setback planting appropriate species and shape
- Planting trees in locations within the right of way other than directly below the wires – bump out and terrace plantings.





# Bump Out Planting



# Bump Out Planting





# Bump Out Planting







# Set Back Planting





# Set Back Planting





# Set Back Planting



# Set Back Planting





# Space – Tree Species Match



# Space – Tree Species Match





# Be Creative

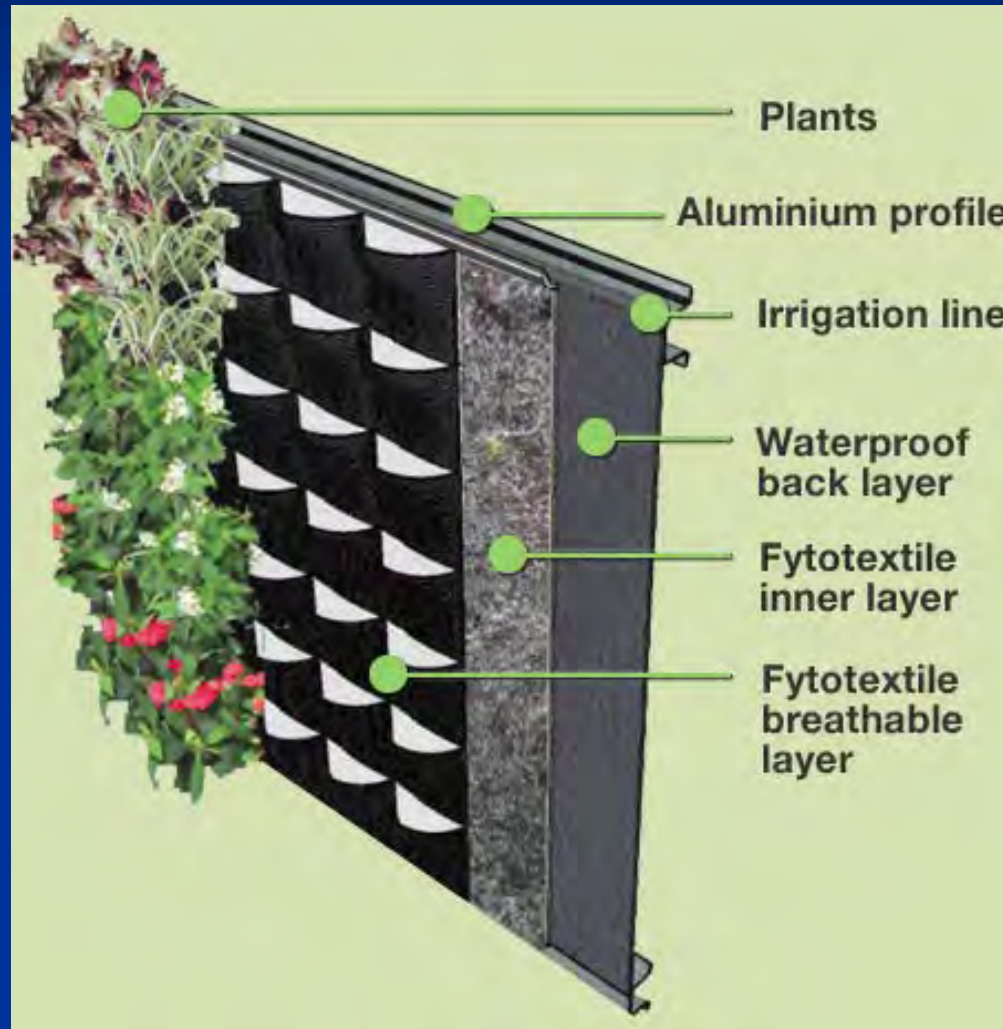


# Be Creative





# Be Creative



# Be Creative





# Be Creative



# Be Creative

















# Design Solutions for Sustainable Streets & Roadsides



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