PLANTING AND CARING FOR TREES

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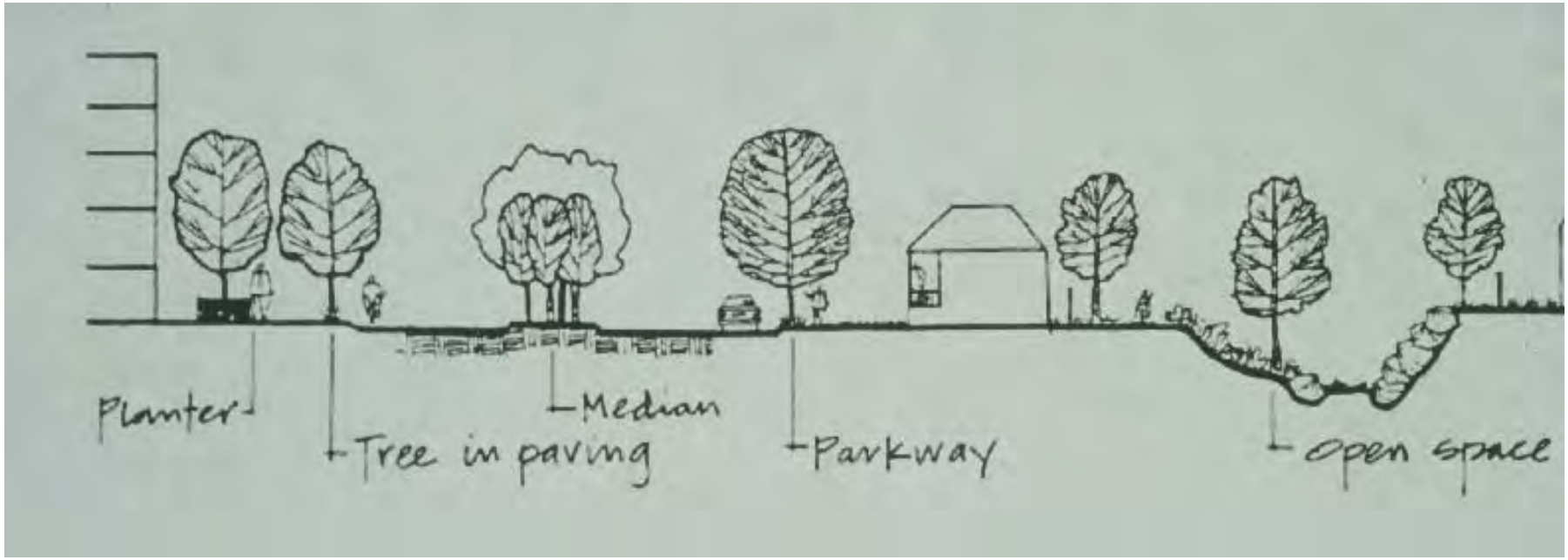
THE URBAN FOREST



79.4 billion trees in metropolitan areas, 4 billion in urban.
Effects 80% of the U.S. populations quality of life.

Most on private property.

ECOSYSTEM SERVICES: HUMAN HEALTH

Relieve stress
Lower health risks
Speed recovery times
Improve concentration and work
Lower crime and domestic violence
Children and ADHD

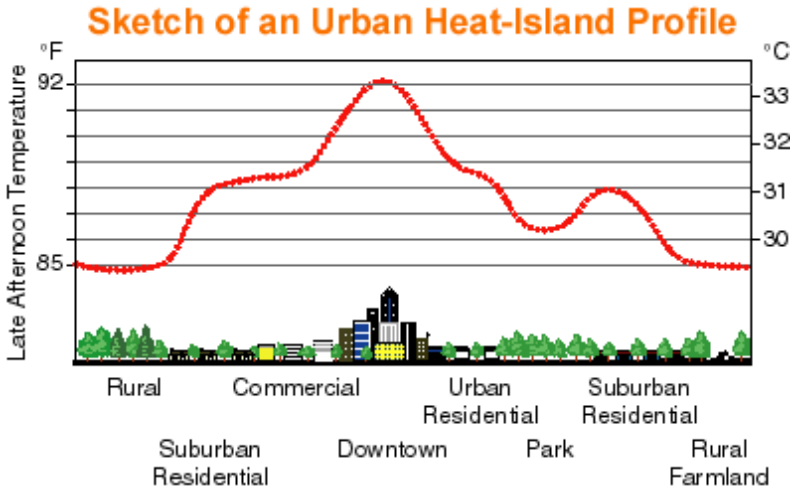
Ulrich, 1983
Taylor et al., 1998
Kuo and Sullivan, 2001
Irwin, 2002
Kuo, 2003

HUMAN HEALTH

ENVIRONMENTAL HEALTH

Reduce air pollution-sequester carbon
Habitat and biodiversity
Reduce heat and mitigate “heat-island”
Stormwater management and “green infrastructure”

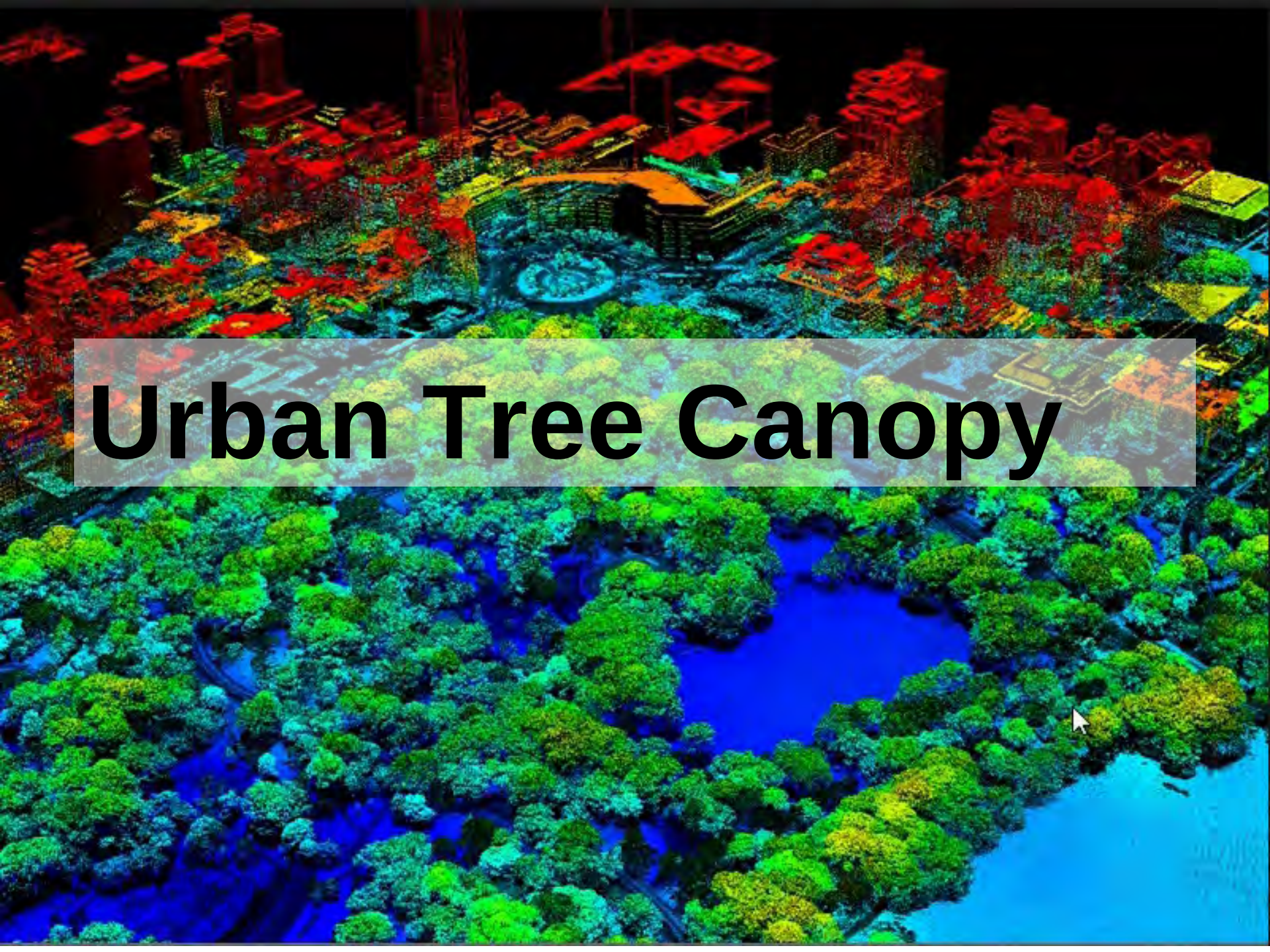
Naeem et al., 1997
Dwyer et al., 2000
Nowak et al., 2007
Gies, 2009



ECONOMIC HEALTH AND COMMUNITY DEVELOPMENT

Increase property values and taxes
Increase business sales and taxes
Attract investment
Sense of place
Community development

Irwin, 2002
Lutzenhiser and Nolusil, 2002
Elmendorf, 2008


Urban Tree Canopy

CANOPY GOALS

Table 6. Example Forest Cover Goals for Four Watershed Scenarios			
Watershed Type	Impervious Cover %	Forest Cover Goal	Benefits of Forest Cover
Suburban-Forested	< 25	60% minimum with 70% riparian forest cover	• Maintain aquatic ecosystem • Improve filtering capacity • Wildlife habitat • Stream protection
Suburban-Agricultural	< 25	40-50% minimum	• Maintain aquatic ecosystem • Improve filtering capacity • Wildlife habitat • Stream protection
Urban-Suburban	26 to 60	25-40% minimum	• Storm water runoff reduction • Reduce urban heat island • Wildlife habitat • Increase esthetic value • Provide recreational opportunities
Urban	> 60	15-25% minimum	• Reduce urban heat island • Storm water runoff reduction • Public health and air quality • Community livability

NHD·28M

WHAT DO TREES NEED TO GROW?

Trees need water, space, soil nutrients, sunlight, and freedom from injury and disease.

Tree establishment is providing care so roots will grow to a point where they start doing their job.

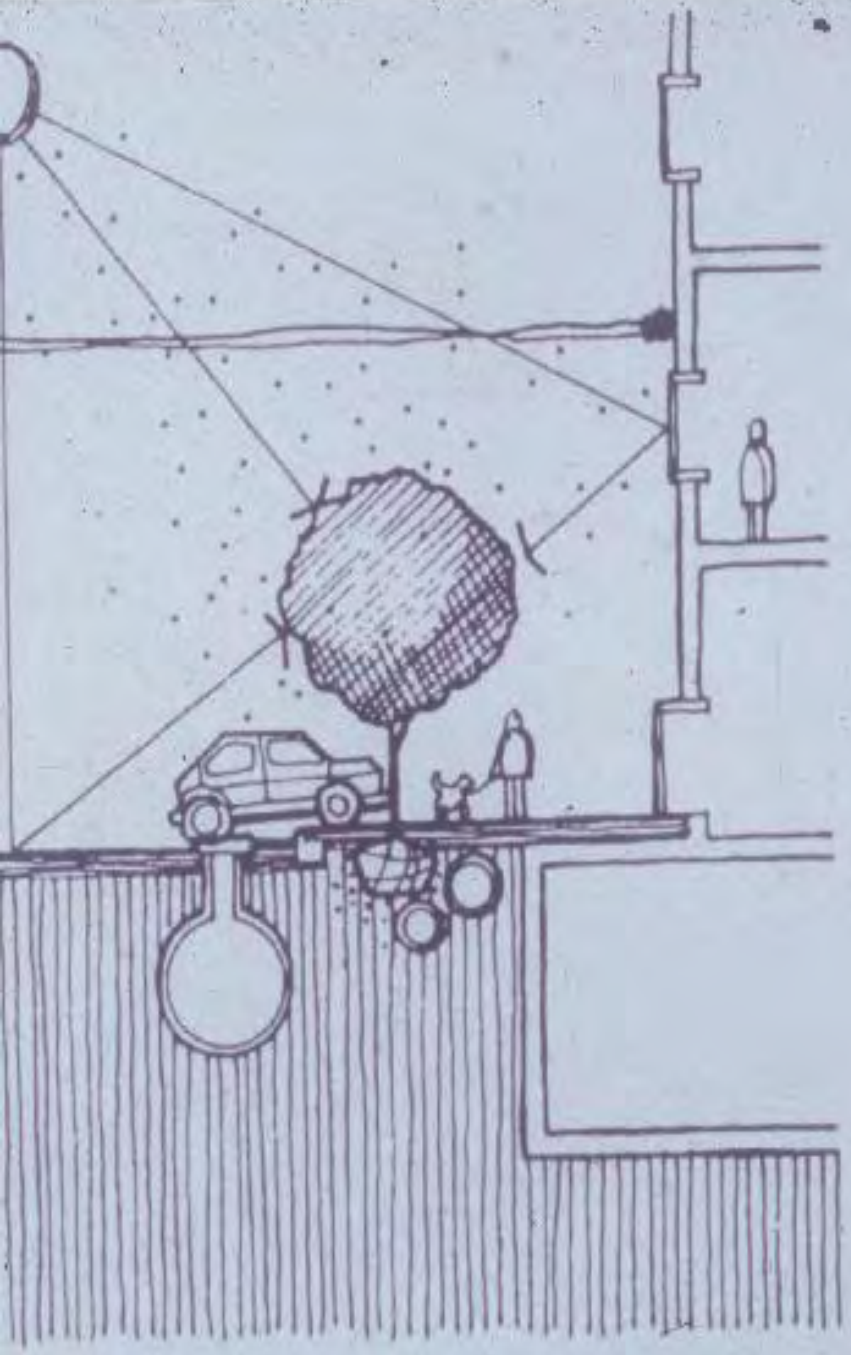
TOUGH PLANTING AREAS AROUND PEOPLE

For successful tree planting you must understand:

site where tree is being planted,

tolerances of the tree, and

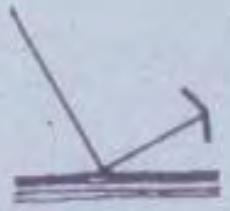
characteristics of the tree you desire.



STRESSES ON URBAN STREET TREES

CONTAMINANTS

POWER LINES



RADIATION

SOIL COMPACTION

UTILITIES

SEWER

from "The Granite Garden"

TROUBLED
URBAN
ROOTS

SITE ANALYSIS

Climate and Weather
- Temperature
- Moisture
- Light
- Wind

Soil
- Compaction
- Drainage
- Fertility
- Depth/Amount
- pH
- Salinity
- Contamination and Pollution

Growing Area
- Space
- Utilities
- Conflicts
- **Attitudes of people**

STOP

½ PRIX
99.**

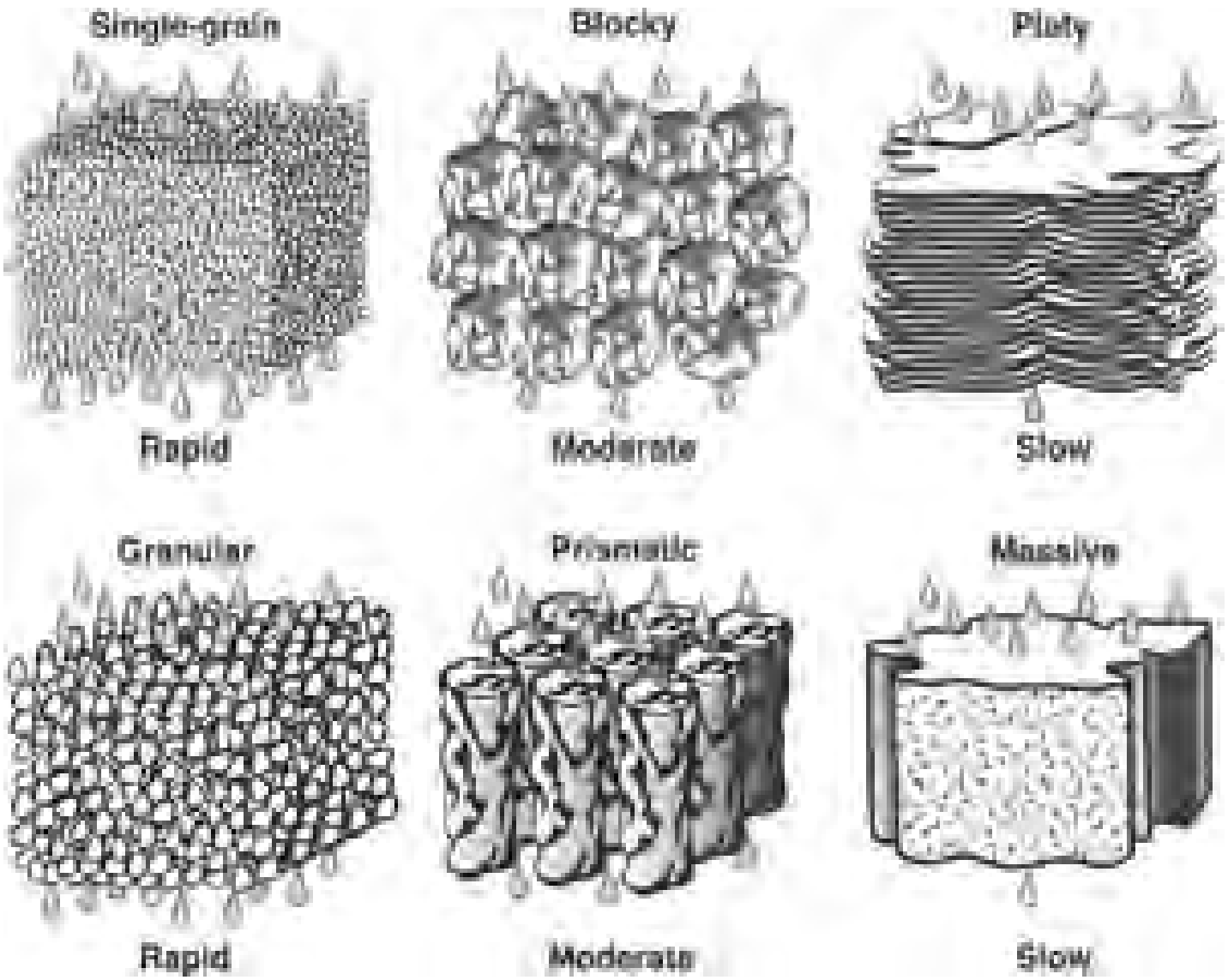
SOIL HEALTH IS IMPORTANT!

Texture- Percent particles clay, silt, sand, and gravel.

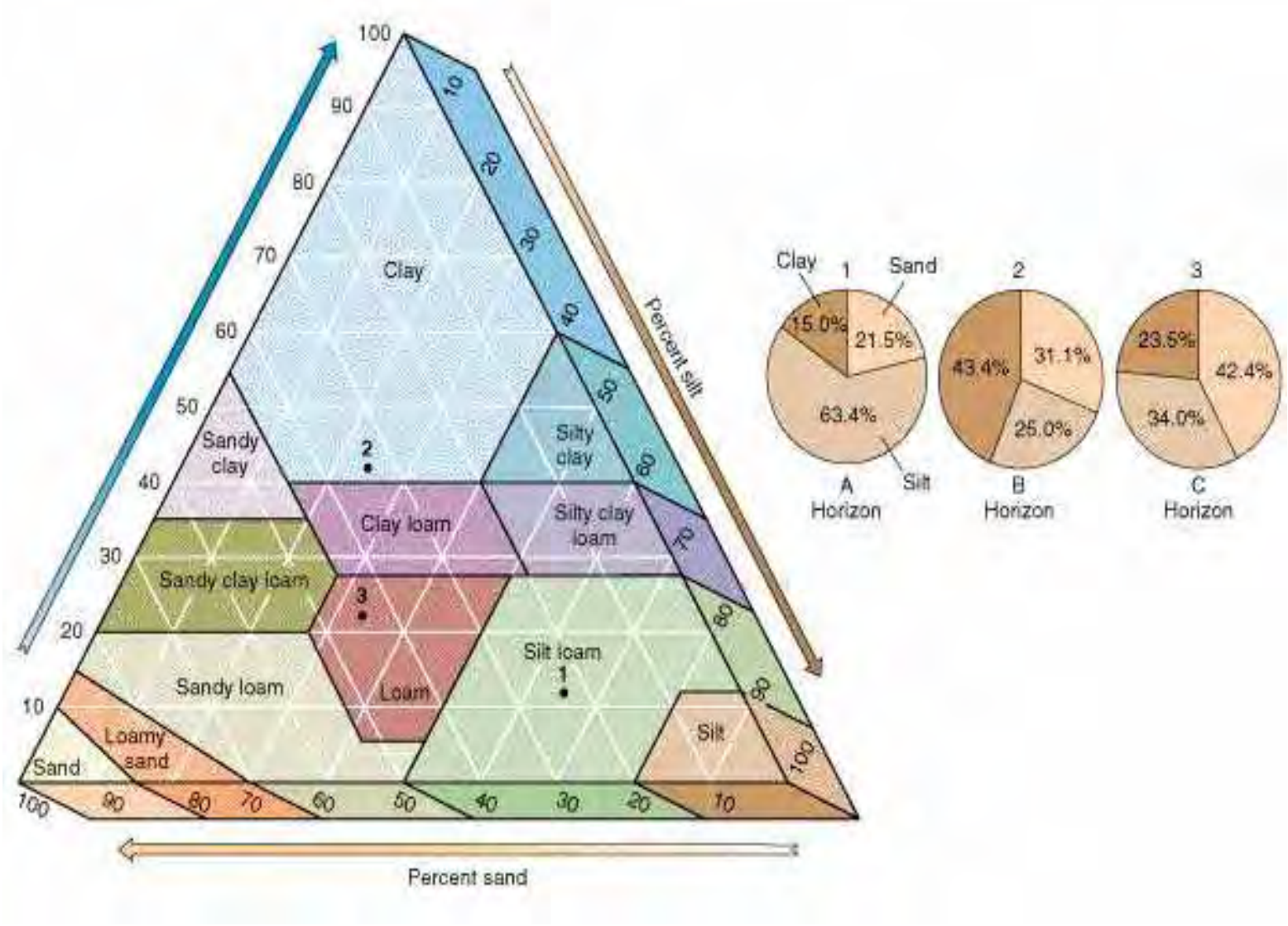
Structure- Soil particle aggregation over time due to weather, organic material, and other forces (e.g., gravity).

These impact soil compaction, fertility, and pH.

SOIL STRUCTURE



SOIL TEXTURE



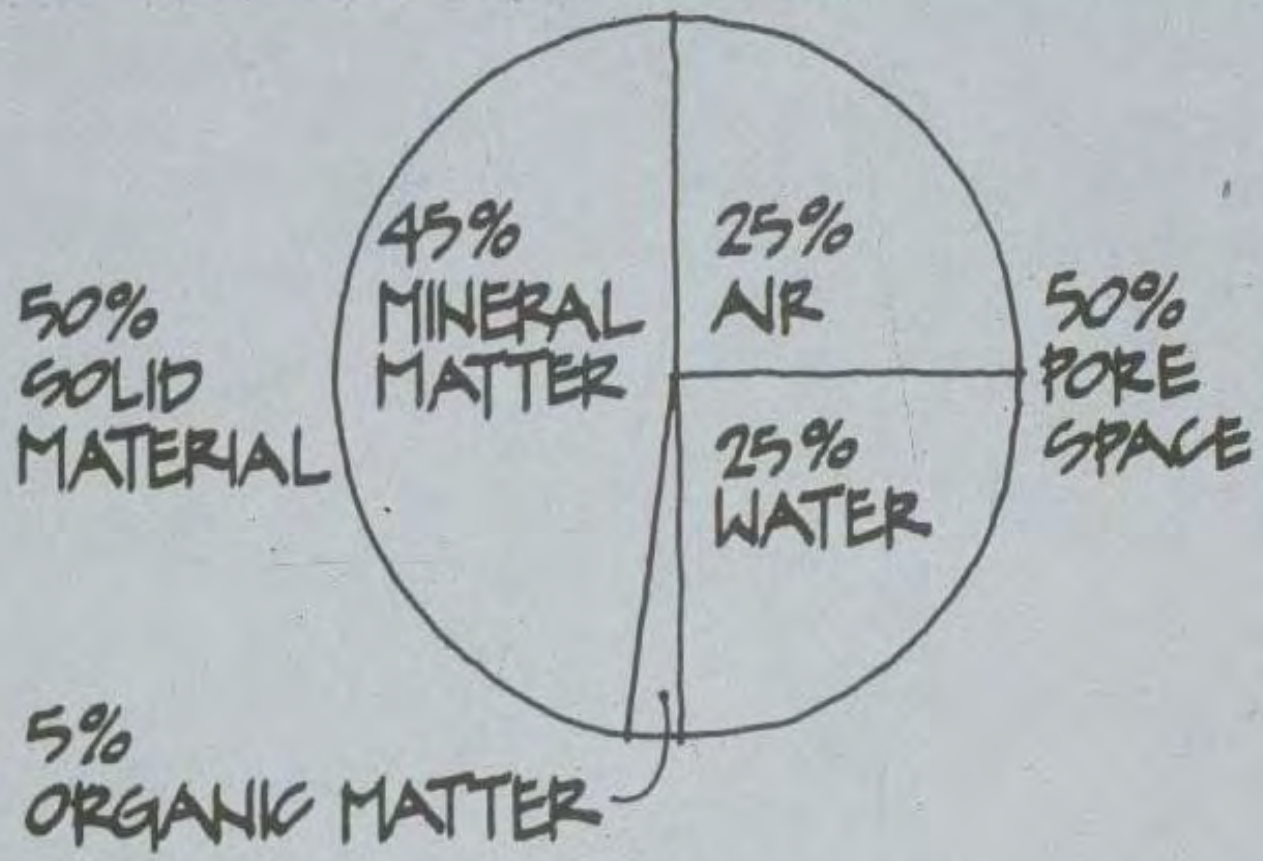
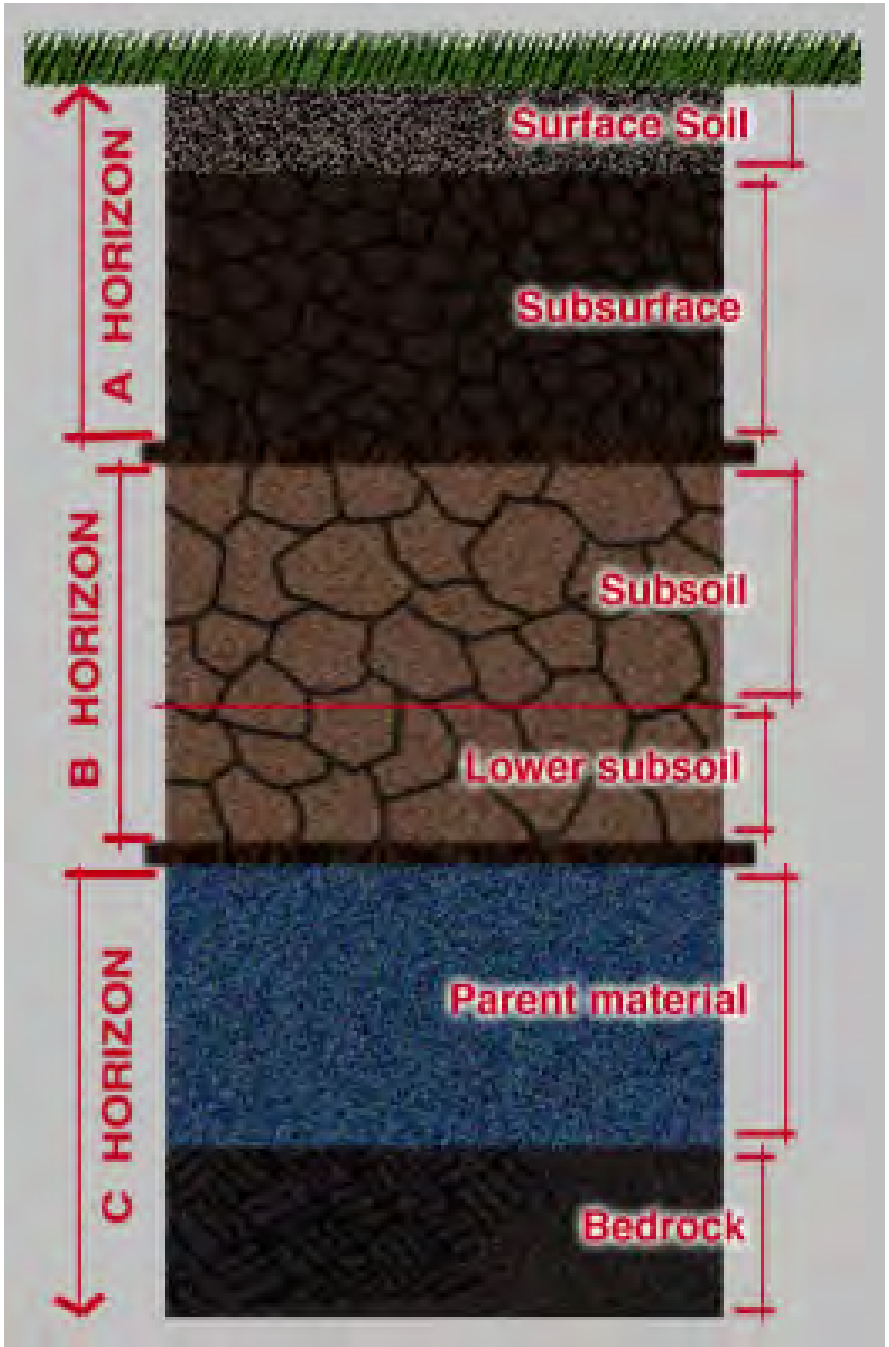


Figure 11-1. Composition of a Desirable Urban Surface Soil

SOIL HORIZON



“A” HORIZON IS GONE

MORE FERTILE SOIL

MADE SOILS

WHAT WE NEED TO KNOW ABOUT SOIL

Structure and pH (slightly acidic)

Nutrient and organic content (organic material around 10%)

Contaminates (salt)

Drainage (1in./1hr.)

Bulk density (1.4 – 1.6 g/cu cm: measure of weight by volume)

UNDERSTANDING TREE TOLERANCES AND CHARACTERISTICS

IMPORTANT TREE TOLERANCES

Drought
Compaction
Pollution
Insect
Disease
Decay

IMPORTANT TREE CHARACTERISTICS

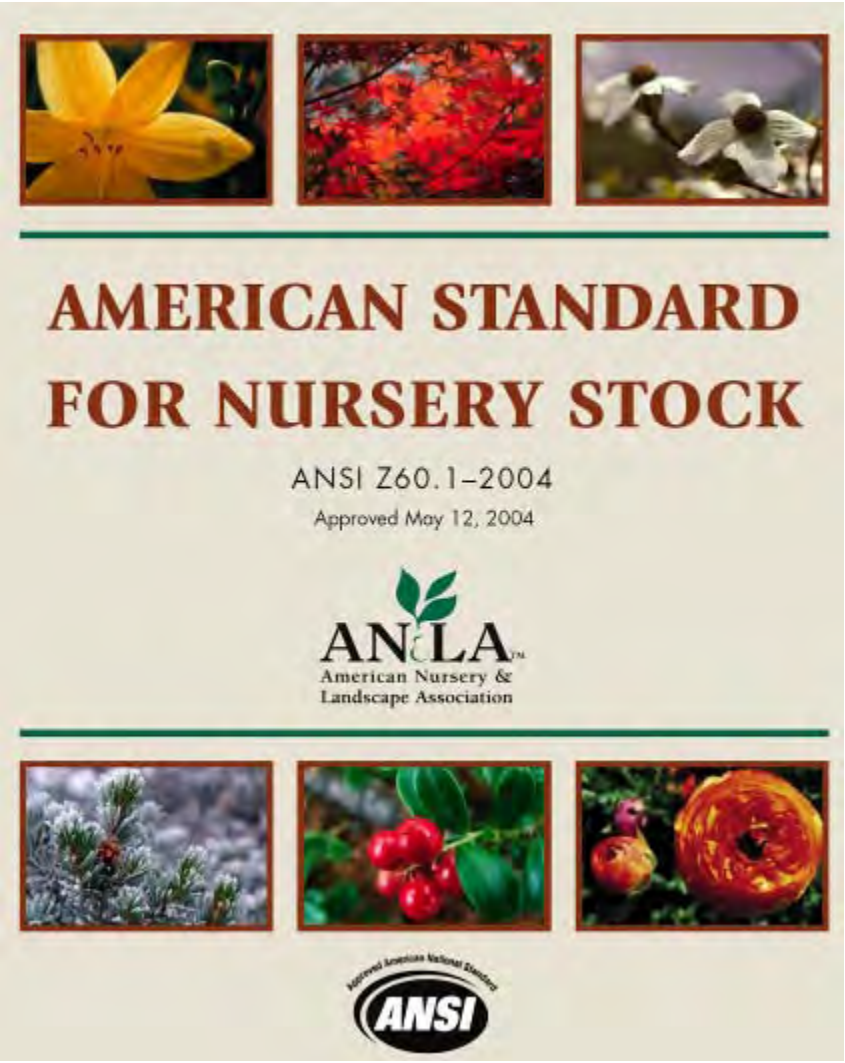
Spring flowers
Fall Color
Branch Attachment
Architecture
Growth Rate
Life
Wood Strength

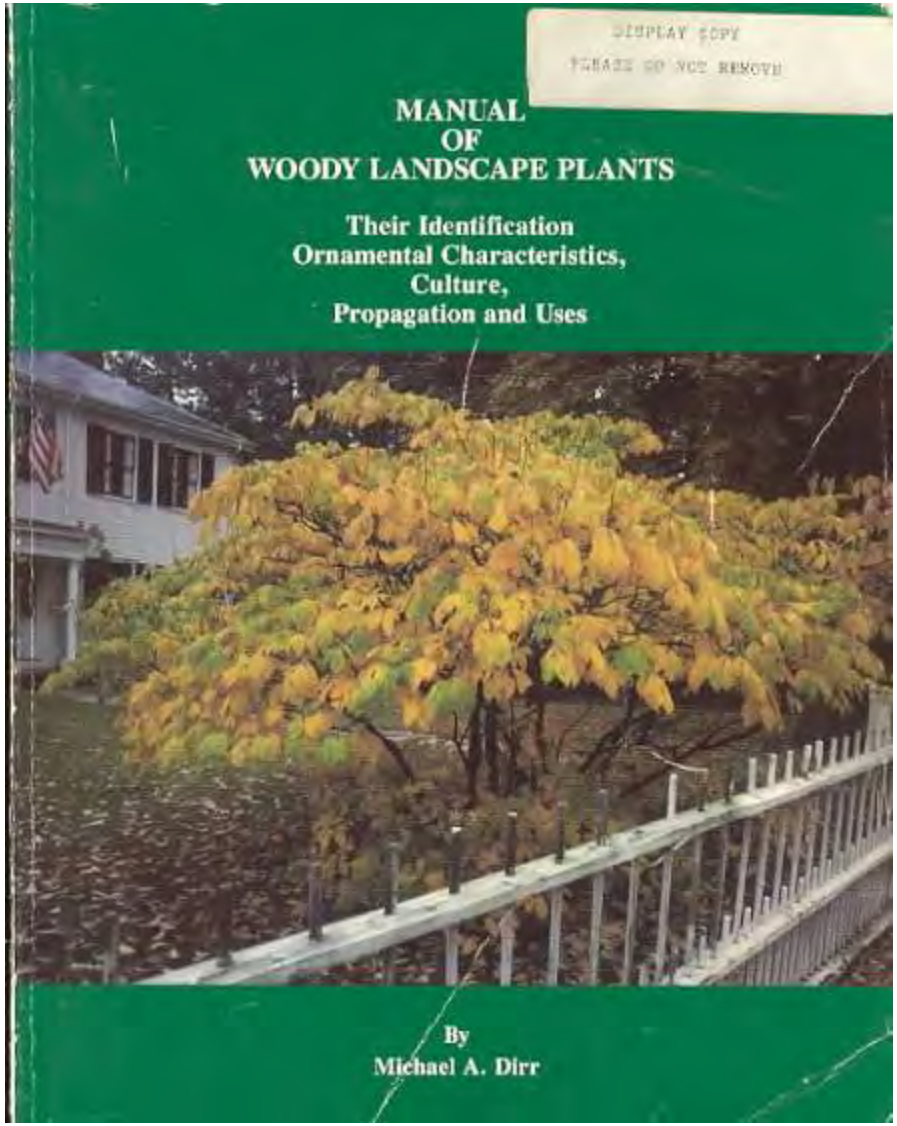
MATCH TREE TOLERANCES AND CHARACTERISTICS WITH PLANTING SITE

- Understand site and tree to chose and plant tree correctly.
- “Plan” for tree planting.
- Plant the “right tree in the right spot.”

APPROPRIATE TREE FOR SITE

NURSERY STANDARDS AND GUIDELINES





PLANTING PROBLEMS AND DISAPPOINTMENT

QUALITY PLANT MATERIAL

- Straight trunk with good taper.
- Appropriately spaced branches.
- Healthy foliage.
- No insect/disease damage.
- Firm rootball; non-synthetic burlap.
- No roots growing from container.
- No circling roots in container.

QUALITY NURSERY STOCK

Look for:

tree with good condition,

good structure **characteristic of species**, and

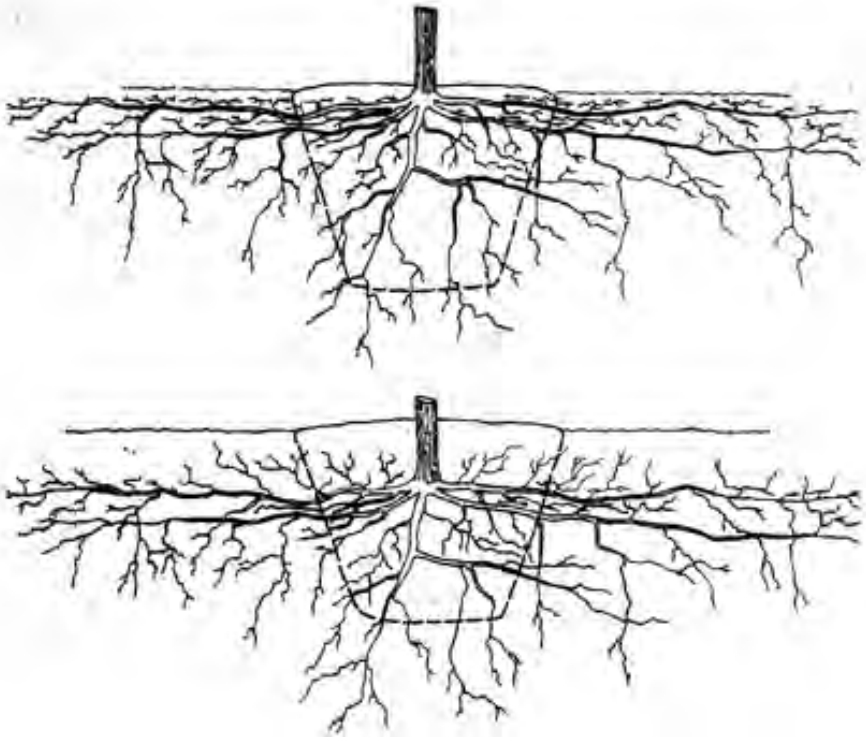
good root growth and health.

ANSONIA 8
WELLSBORO

BALLED-AND BURLAPPED TOO DEEP

LACK OF ROOTS FROM NURSERY

CASE



CONTAINERIZED/POT-AND-POT

CONTAINERIZED TREES

- 100% of root system moved.
- Soil-less growing media dries out quickly.
- Constant Irrigation in nursery.

Circling roots

ROOT-BOUND

Too many roots are on outside of root ball, circling around container.

BARE ROOT

BACK TO BARE ROOT

- Roots dipped in hydrogel.
- 10-14 days holding (mulched).
- 200% more roots than B&B.
- Select species - spring and fall.

BACK TO BARE ROOT

Dug and planted at correct time.

Transported and stored correctly.

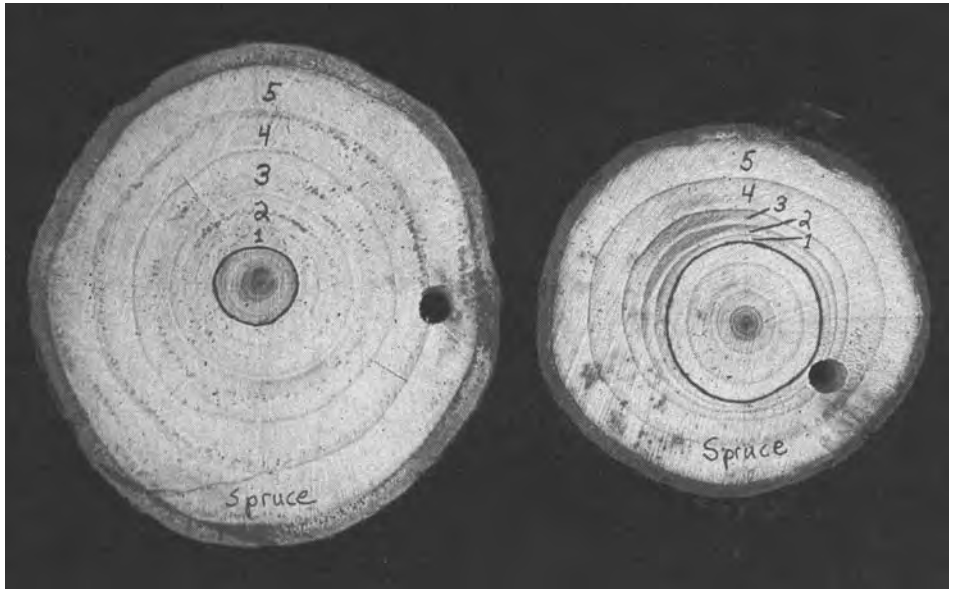
Good volunteer organization.

Staked and watered.

DOES SIZE MATTER?

- Larger trees take longer to establish and grow back roots.

- Smaller transplants out-grew larger transplants in trunk diameter growth.



PLANTING SITE PREPARATION

Disturb, <u>or provide,</u> as much fertile soil as possible.

Provide enough space for establishment and growth.

YARDS AND PARKS

Compacted soils always a problem.

Provide as much fertile, non-compacted soil as possible.

PARKS: DIG LARGER PLANTING HOLES

PARKS: WIDER PLANTING HOLES

PLANTING IN COMPACTED SOILS

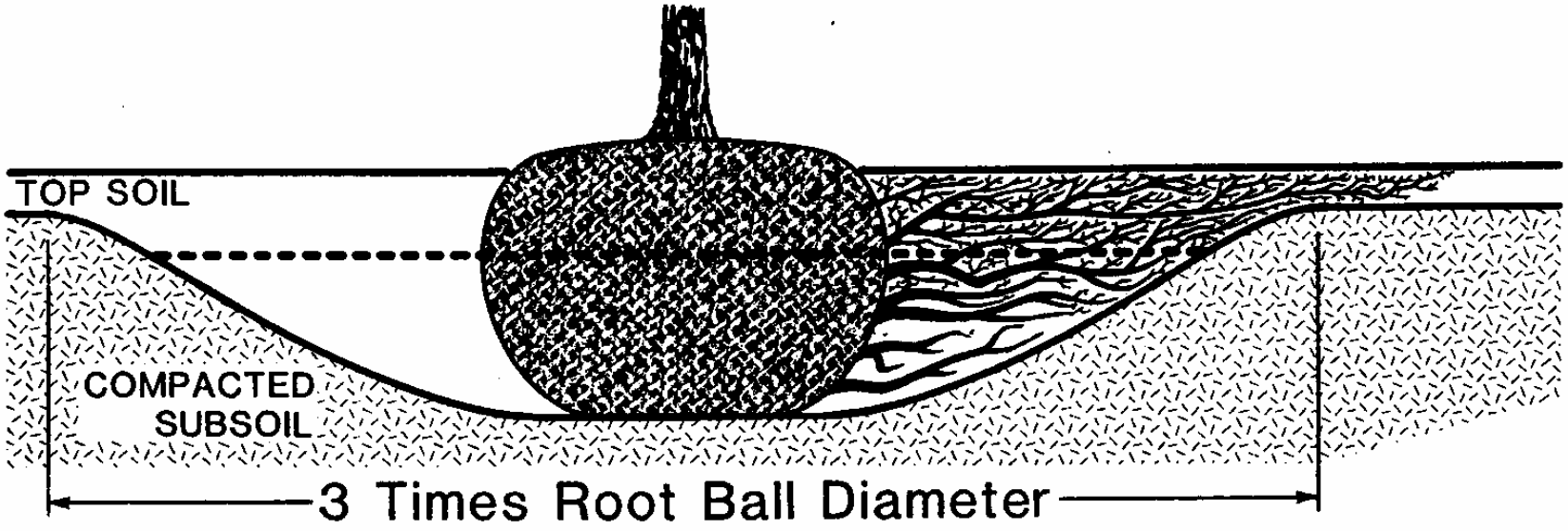
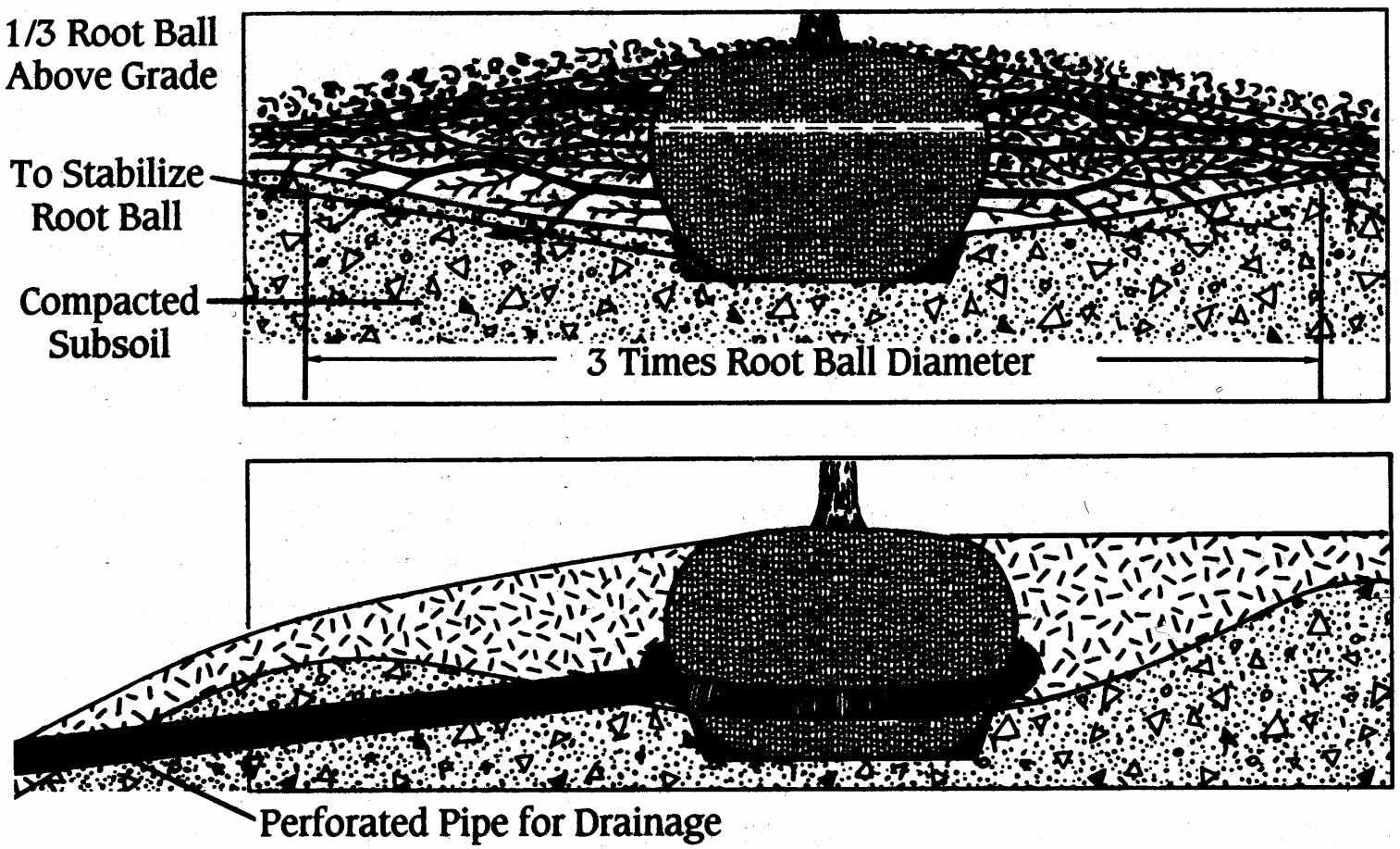
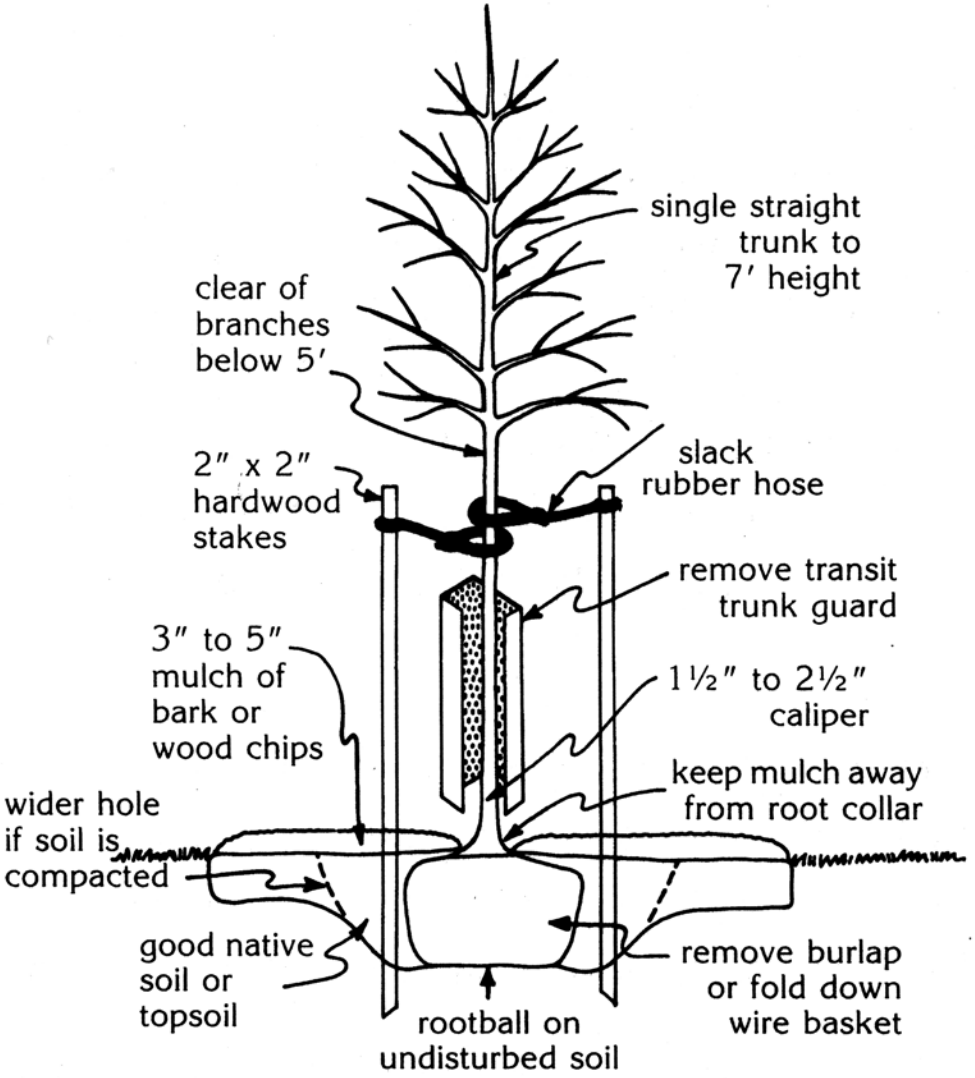


FIGURE 3-3. If roots have difficulty penetrating compacted site soils, sloped sides allow roots to continue to grow vigorously toward the better soils near the surface rather than being trapped in the planting hole. Roots that do penetrate the site soil along the slope will grow more slowly.

COMPACTED SOILS AND POOR DRAINAGE



IMPORTANT IN TREE PLANTING



Match tree with site.

Provide space.

Disturb or provide soil.

Prepare site correctly (see above).

Plant correctly.

Provide proper after care.

PLANT TREE AT RIGHT DEPTH

REMOVE WIRE BASKET

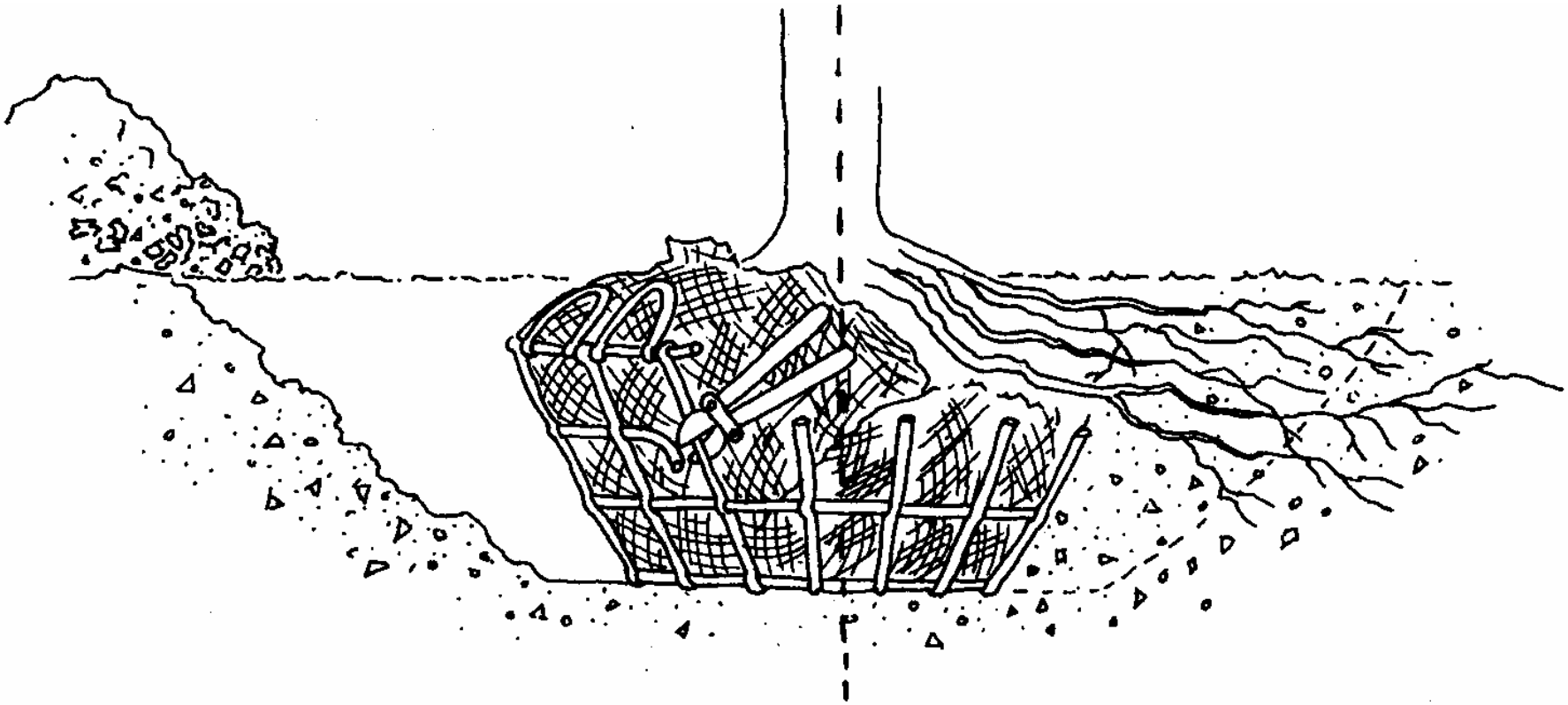


FIGURE 7-7. If the upper half of the basket is removed before backfilling, most future root problems will be prevented.

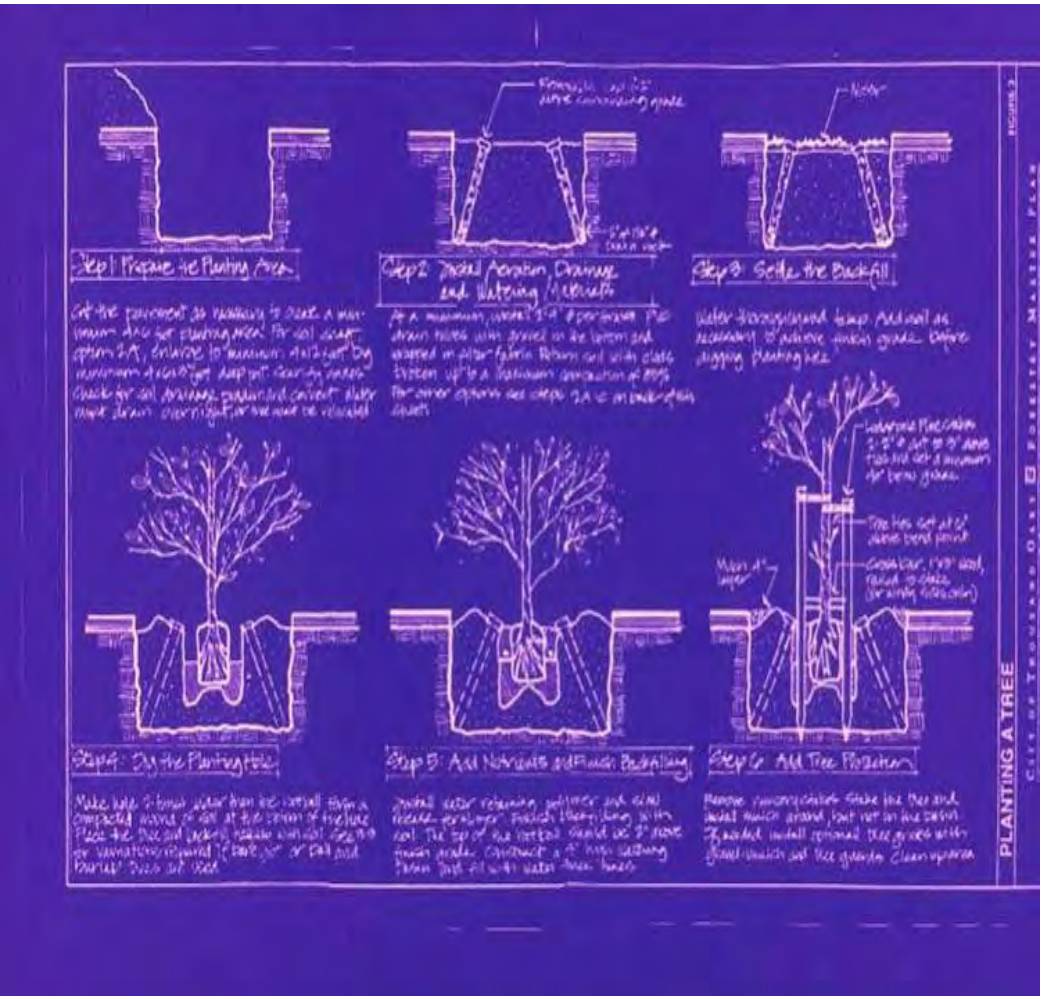
SIDEWALK PLANTING SITE PREPARATION

Disturb, or provide, as much fertile soil as possible.

Provide space for establishment and growth.

MORE FERTILE SOIL

PLANTING PITS



Disturb, or provide, as much fertile soil as possible.

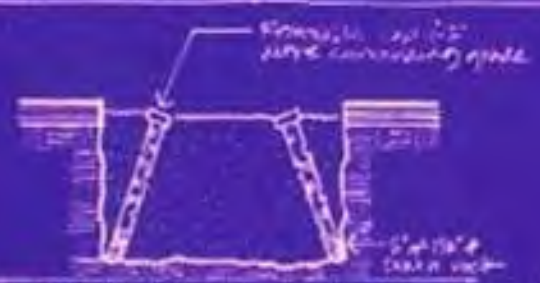
Prevent hardscape damage (e.g., space, engineered soils).

Promote deep root growth.

5’X5’X3’ minimum planting pits.

Step 1: Prepare the Planting Area

Cut the pavement as necessary to create a maximum area for planting area. For soil volume options 2-A, enlarge to maximum 4'x12 feet by maximum 4 feet 0" feet deep pit. Clean by hand. Check for soil problems, pavement, cavities, water table, drain pipes, utilities, or tree roots to be relocated.



Step 2: Install Aeration, Drainage and Watering Materials

At a minimum, install 3-4" perforated pipe drain tubes with gravel in the bottom and wrapped in filter fabric. Return soil with glass system up to a maximum dimension of 8'x8'. For other options see steps 2-A & B on back of this sheet.

Step 3: Settle the Backfill

Water thoroughly and tamp. Add soil as necessary to achieve finish grade. Before digging planting hole.

Step 4: Dig the Planting Hole

Make hole 3 times wider than the rootball from a compacted mound of soil at the center of the hole. Place the tree and backfill, adjusting depth or variations required to have top of root ball flush with finish grade.

Step 5: Add Materials and Finish Backfilling

Install water retaining polymer and other release additives. Finish filling hole with soil. The top of the rootball should be 2" above finish grade. Construct a 4" high watering basin. Drench with water three times.

Step 6: Add Tree Protection

Remove nursery stakes. Stake the tree and install mulch around root ball on the basin. If needed, install removal tree guards with gravel/mulch and tree grates. Clean up area.

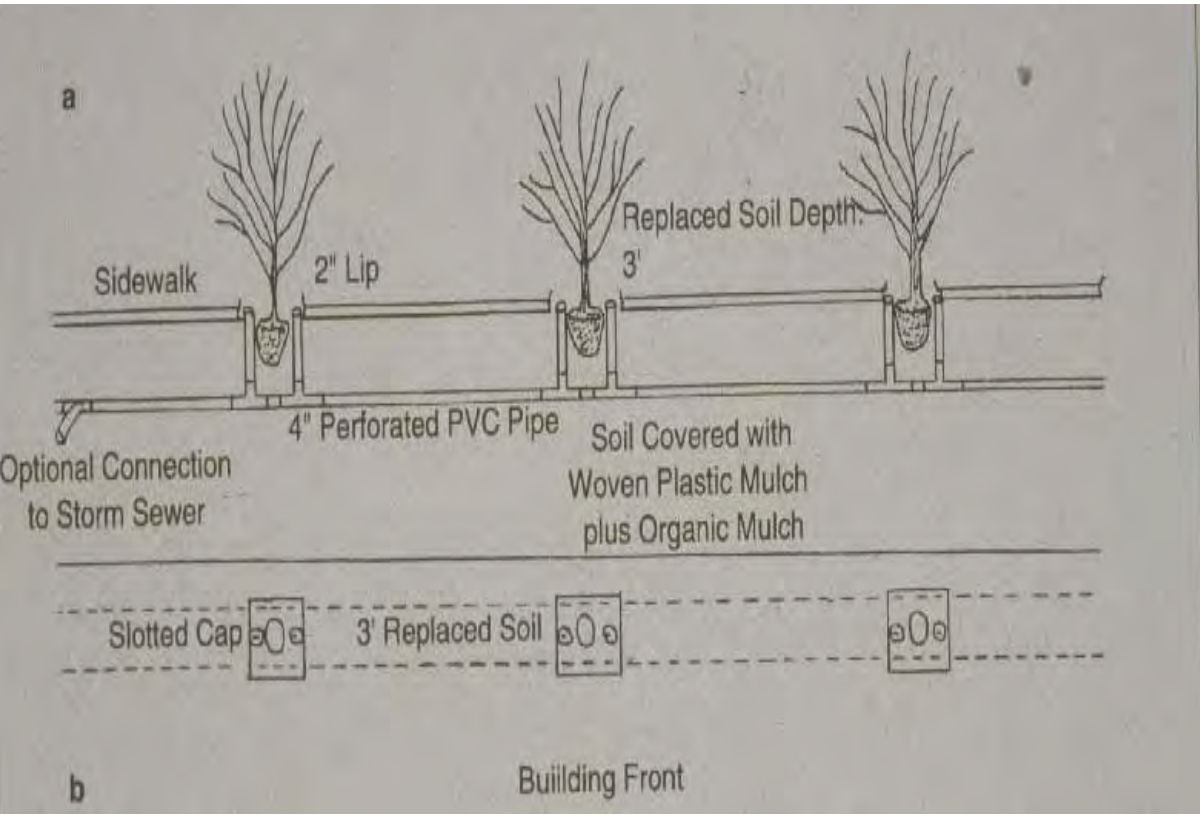
PLANTING A TREE

FIGURE 2

CITY OF TORONTO ■ URBAN FORESTRY

NO
STOPPING
ANY
TIME

CONTINUOUSE PLANTERS



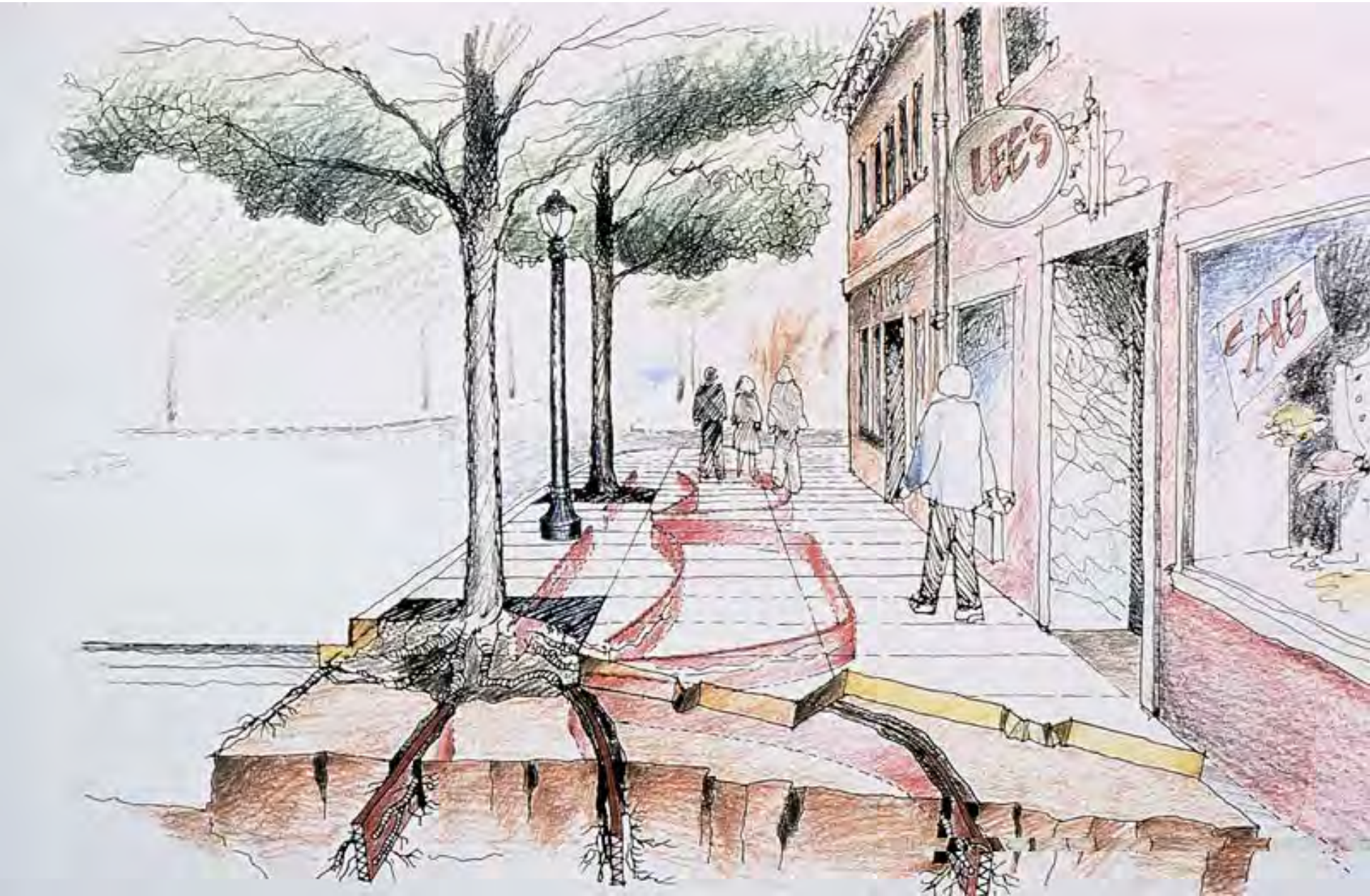
Provide larger volume of fertile soil.

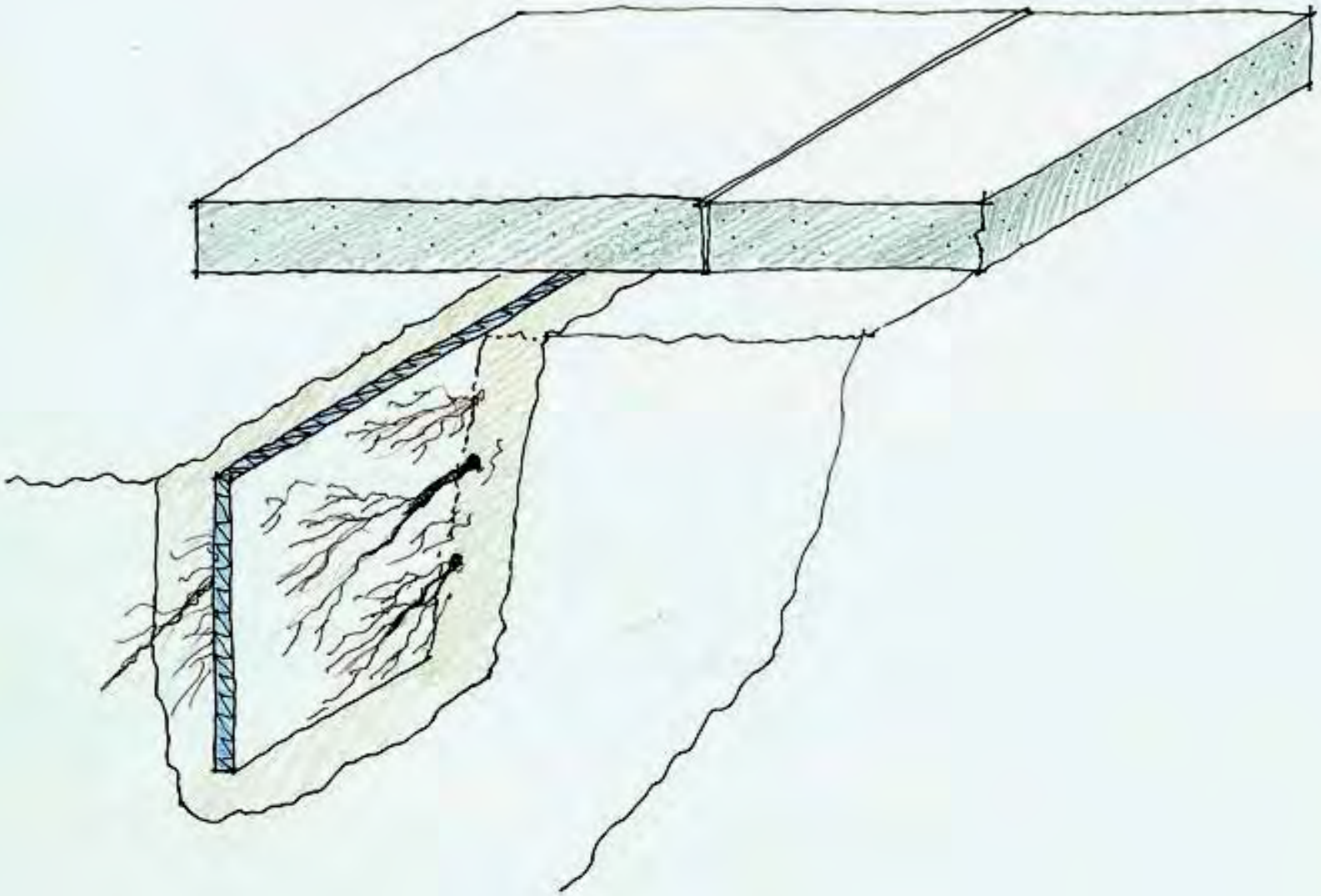
Promote root growth along curb.

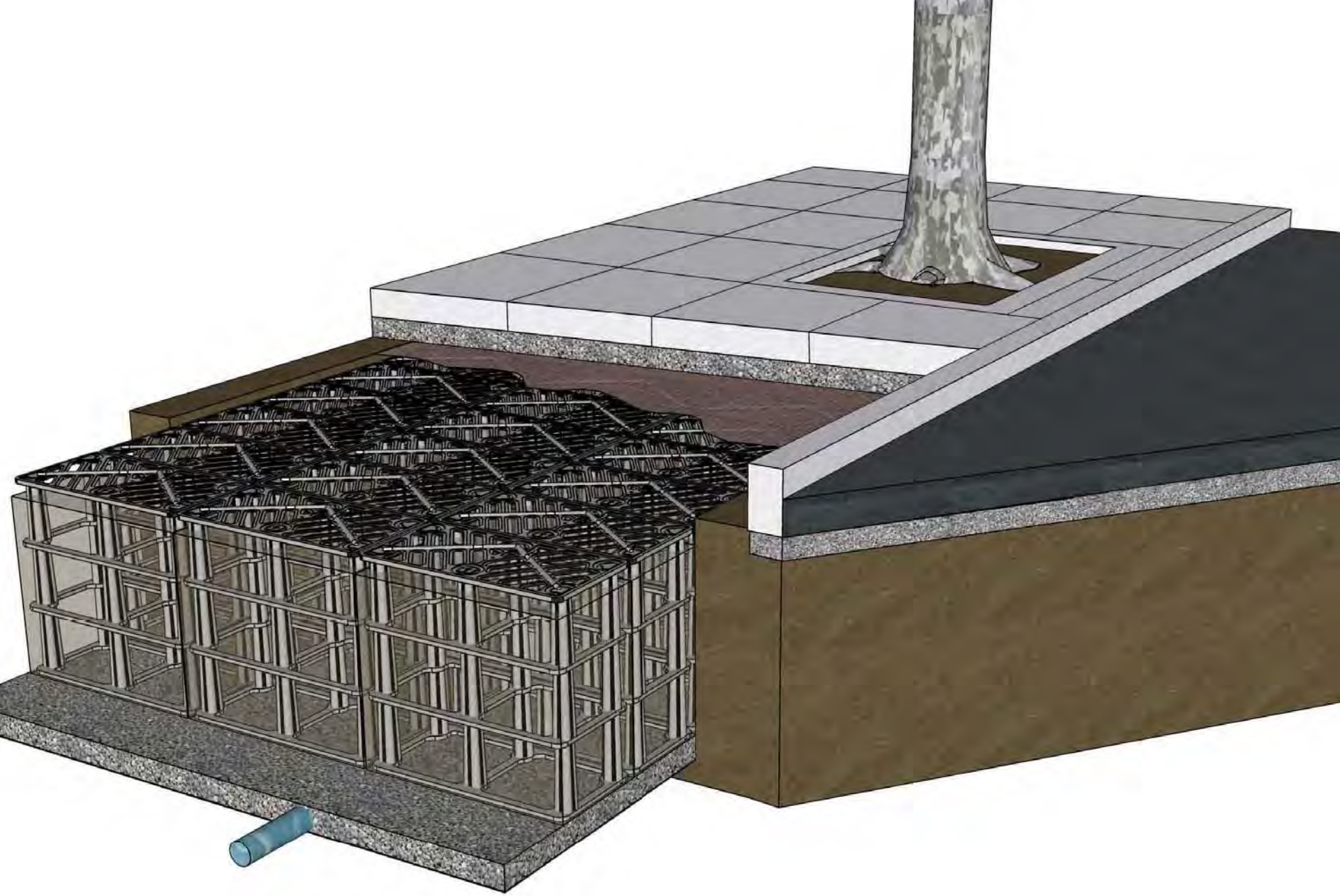
SUBLEASE

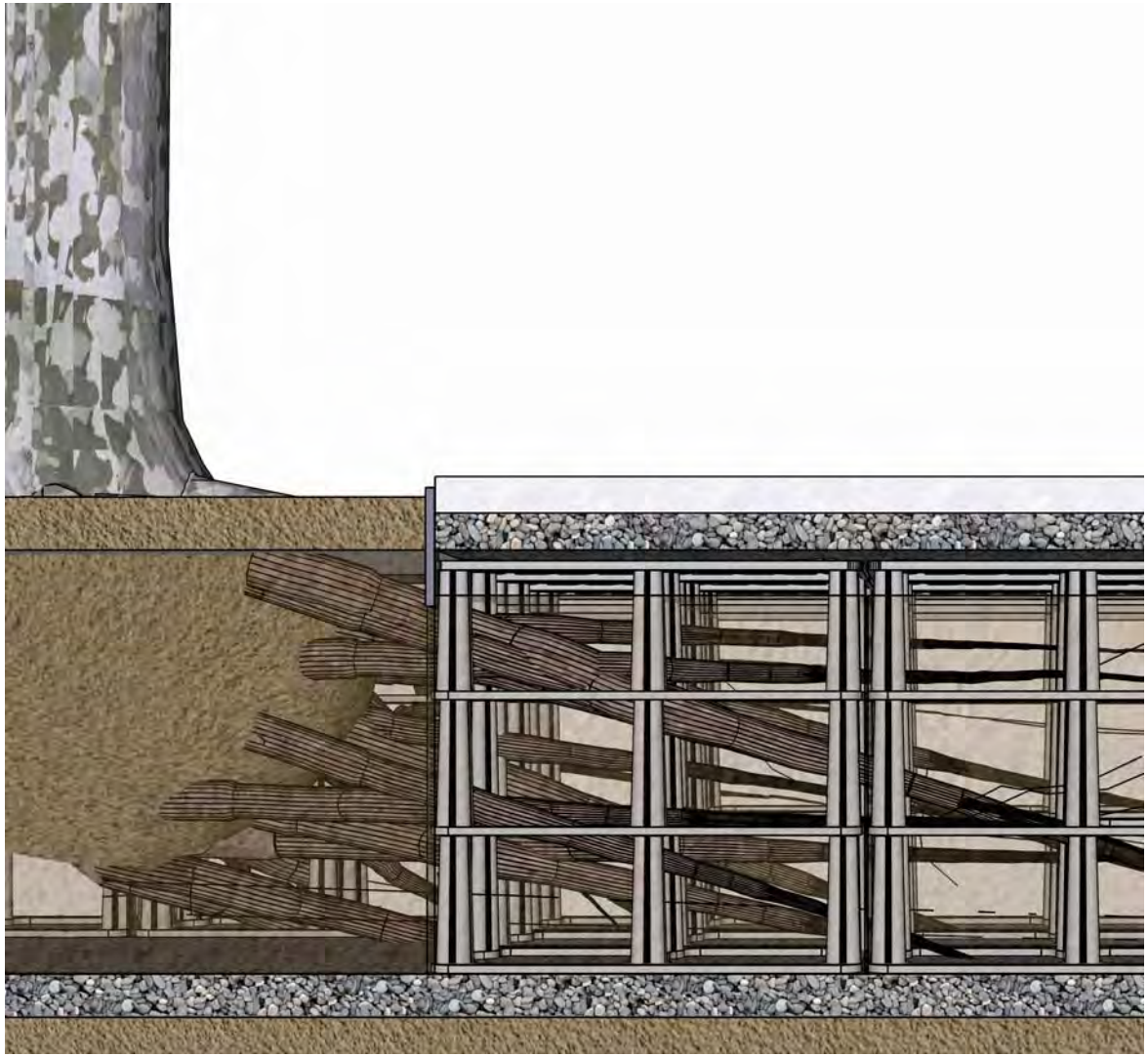
POLICE
SEPTA

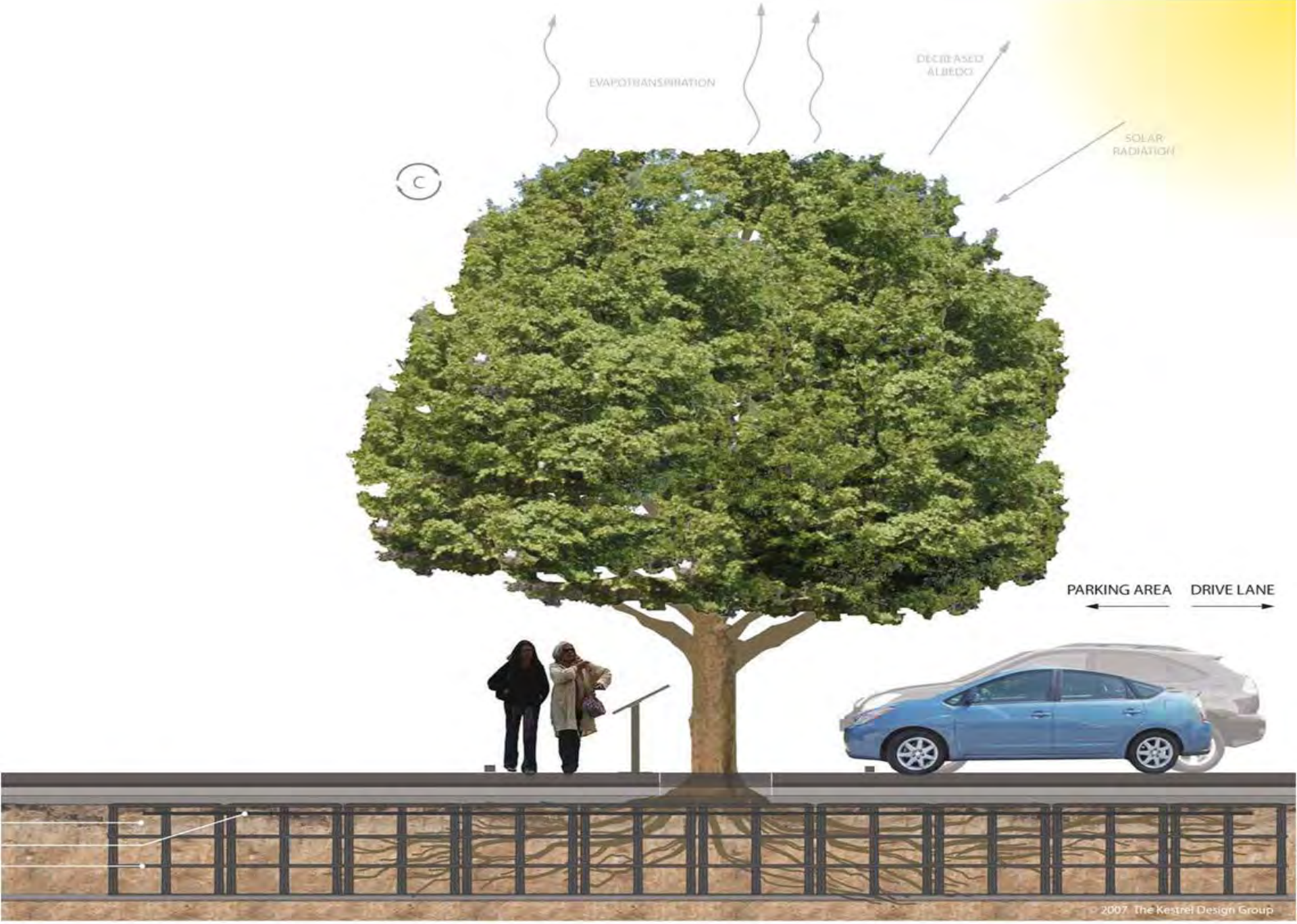
SPECIAL DESIGNS










EVAPOTRANSPIRATION
DECREASED ALBEDO
SOLAR RADIATION
PARKING AREA
DRIVE LANE
© 2007 The Kestrel Design Group

CORNELL UNIVERSITY-STRUCTURAL SOIL

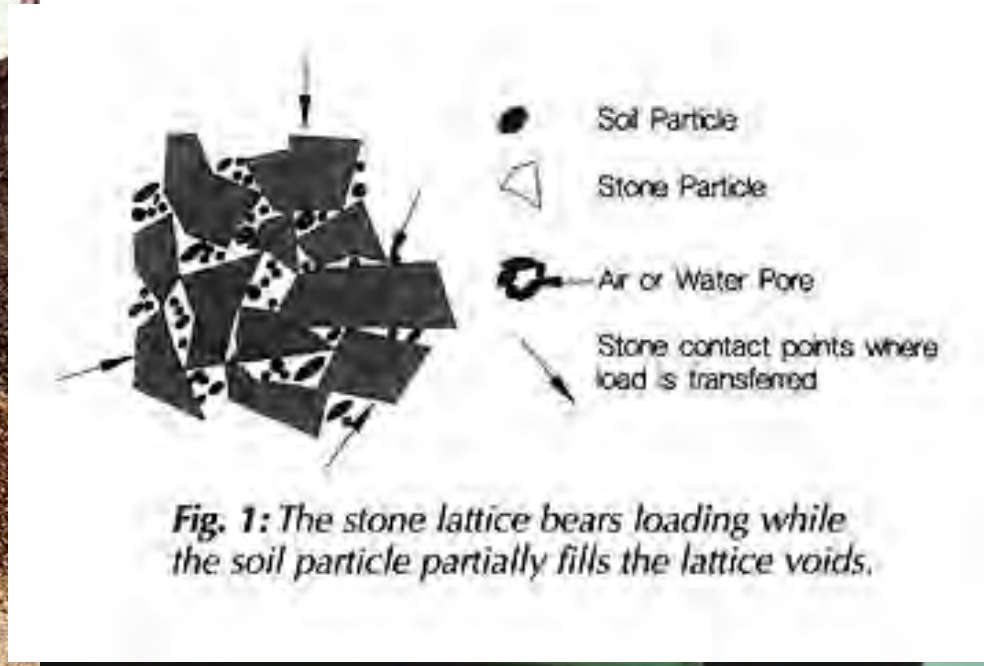


Fig. 1: The stone lattice bears loading while the soil particle partially fills the lattice voids.

http://www.hort.cornell.edu/department/faculty/bassuk/uhi/

STRUCTURAL SOILS

EAST
BUSINESS
6

WORK WITH ENGINEERS

Permeable concrete (less fines).

Brick permeable pavers placed in sand.

Concrete angled towards tree cutouts for drainage.

Pipes or curb cutouts allow street water to enter planters along curb.

Trees tolerant of salt and other pollutants.

STAKING

Do you have to stake:

weight of tree,
sandy soil,
wind, and
vandalism and damage

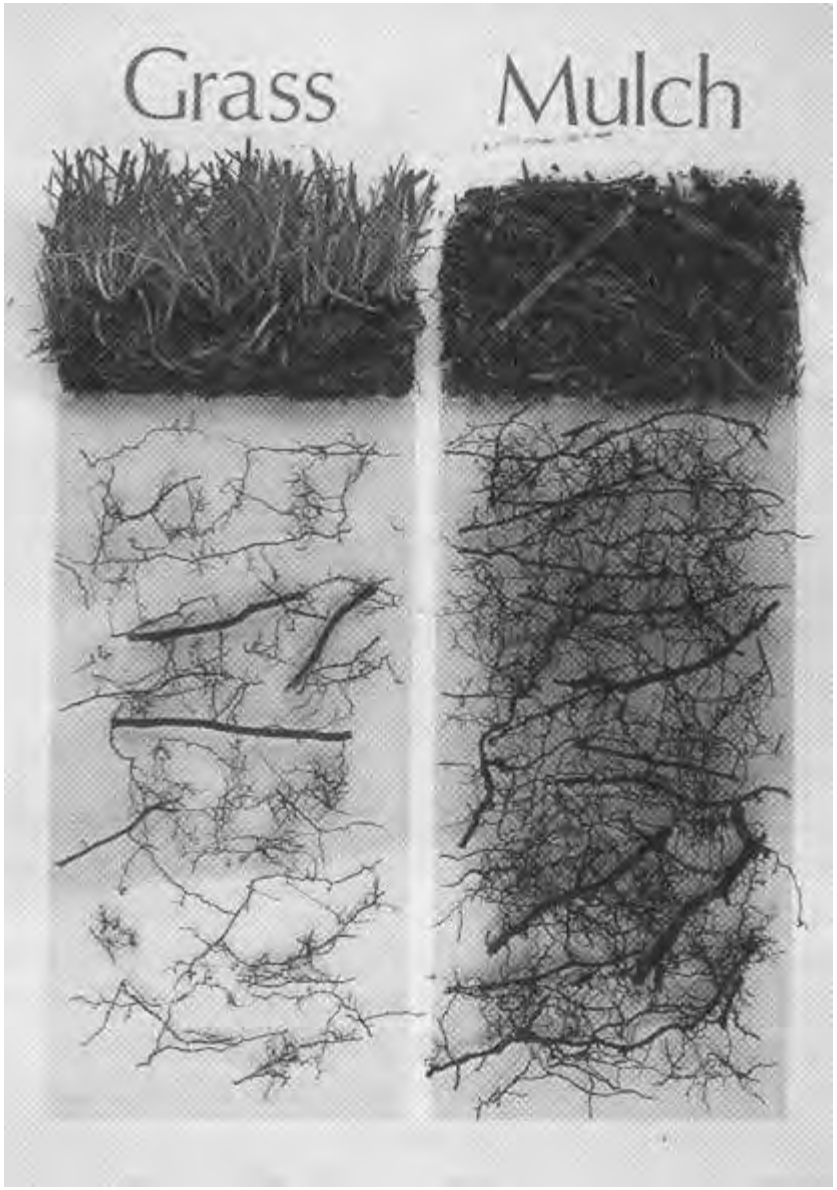
MULCH

Proper mulching does much cheaply.

Use 2-3” or coarse composted mulch.

No mulch on trunk; no mulch mountains.

BENEFITS OF MULCH



Soil fertility

Soil moisture

Soil temperature

Soil structure- aeration and drainage

Organic matter and nutrients

Weed and “whacker” control

PROBLEMS WITH OVER-MULCHING

- Oxygen starvation and root rots.
- Death of phloem and root flare.
- Fungal rots and bacterial infections.
- Extreme drought.
- Rodents.

IRRIGATE TREES AFTER PLANTING

Root balls dry in 4-5 days in summer.

Water must reach bottom of root ball = slow watering.

Containerized and bare-root stock need more irrigation than B&B stock?

1-2 gallons/inch of caliper at least once a week (25 gallons)?

ALL NURSERY STOCK BENEFIT FROM IRRIGATION

Production method	Survival with frequent irrigation after planting	Survival with infrequent irrigation after planting
Container: above ground or pot-in-pot	very good to excellent	fair
Fabric containers in ground	very good to excellent	poor to fair
B&B not root pruned	fair to good	poor to fair
B&B root pruned	excellent	good
Bare root	excellent	good

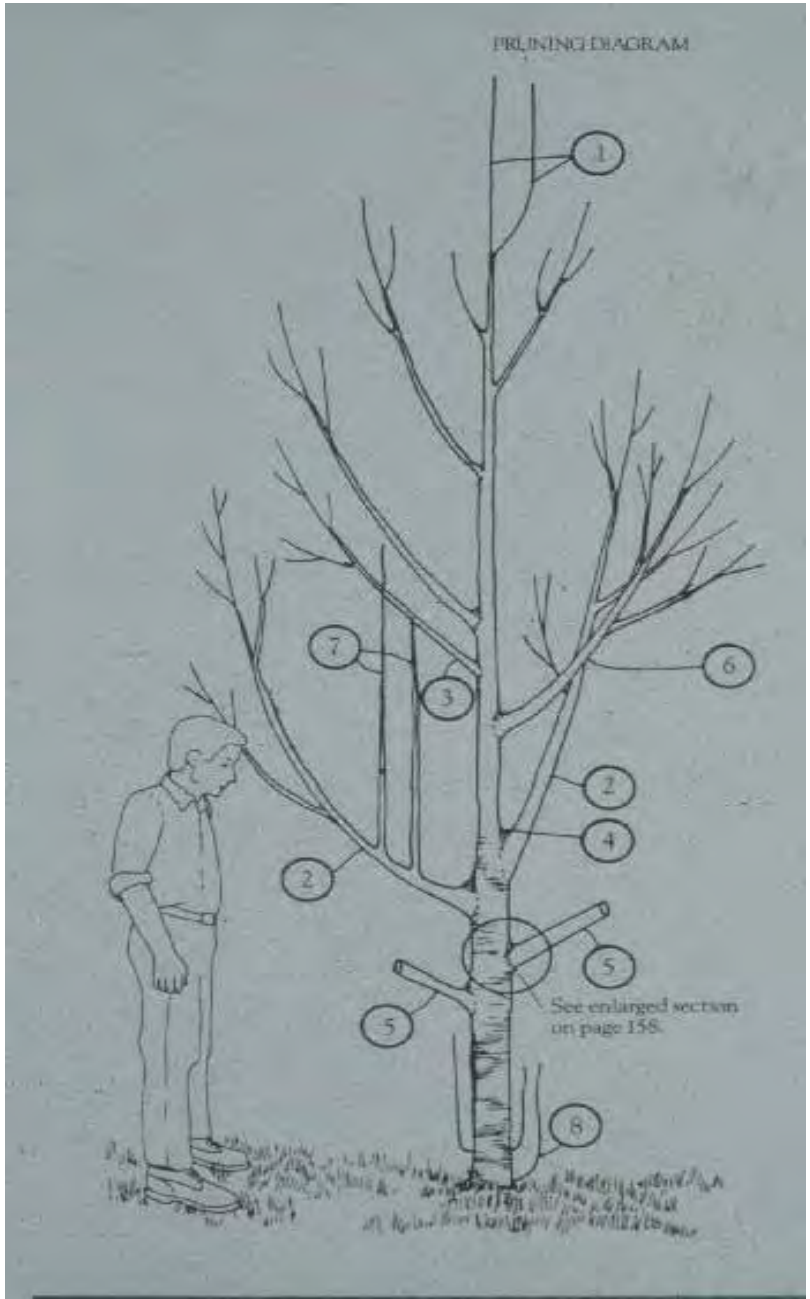
YOUNG TREE TRAINING

Provide proper pruning first three to five years.

No compensatory pruning.

Develop a strong and attractive structure typical of species.

PROPER YOUNG TREE PRUNING



Leave as much green as possible.

Leaves fuel root establishment and growth.

Remove temporary branches slowly as possible.

AMEND BACKFILL SOILS?

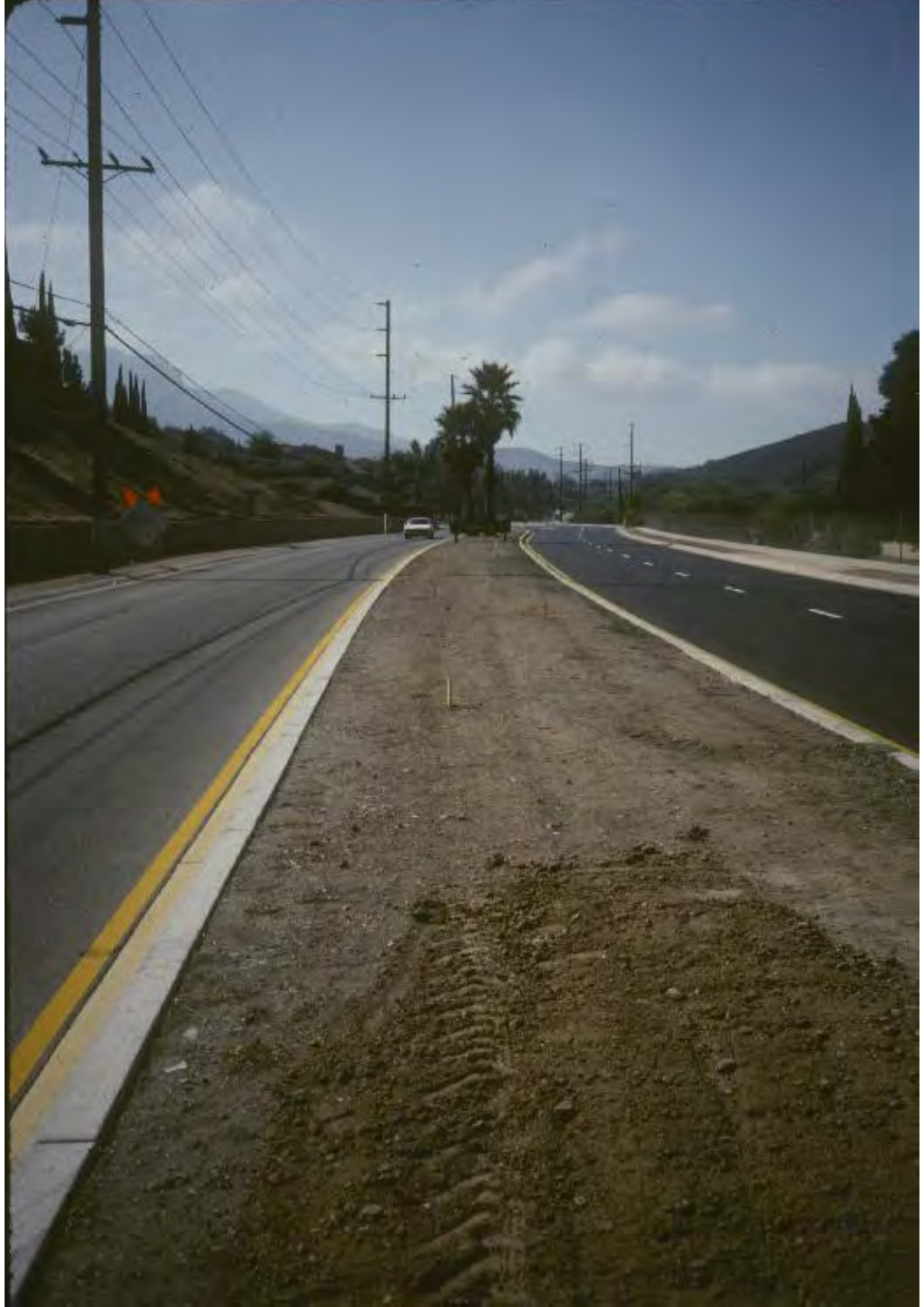
Most research revealed that amendments offer no consistent advantage or may prove harmful = drainage in compacted and clay soils.

Backfill soils should, in most cases, be the soil removed from the hole.

The exception is amending a large planting bed.

Replacement soils should be a similar textured soil = planting hole will never drain.

AMENDING SOILS



FERTILIZE NEWLY PLANTED TREES?

- Research showed no effect of fertilizing, while other research reported response.
- Use a slow release fertilizer, low application rates (1lb N/1000 sq.ft.)

ROOT REGENERATION

NON-WOODY ROOTS

Photo credit - Dr. Alex Shigo, ‘Tree Anatomy’

- Root hairs and young developing mycorrhiza on a hemlock.

- Mycorrhizae are beneficial fungi that colonize roots and help increase absorptive capacity.

- Naturally occur “colonize” in healthy soils.

MYCORRHIZA SOIL INOCULATE

- Is it worth adding to soils?
- Depends- most research on strip mines with conifer trees.
- Other research looked at inoculating potted material.
- Study in France on urban trees showed no significant growth difference after 4 years.
- Suggests watering, fertilizing, mulching, and reduce soil compaction for good colonization.

BIOSTIMULANTS?

Aid root establishment and growth.

Aid establishment and growth in harsh planting sites.

Reduced transpiration in summer plantings.

Aid tree rehabilitation and construction damage.

REDUCING TRANSPLANT SHOCK

- What's in BioStimulants
  - Seaweed Extract
  - Humic Acids
  - Enzymes
  - Amino Acids
  - Mycorrhizal fungi
  - Bacteria
  - Vitamins
  - Wetting agents
  - Carbohydrates/ Sugars

Bio-Plex Transplant Concentrate & Plant Enhancer

Today's solutions ... Tomorrow's technology. Bio-Plex technical concentrate and plant enhancer applied before and/or after digging or transplanting, has set the industry standard for enhancing a plant's ability to survive. Bio-Plex is a biostimulant liquid complex of seaweed extract, humic acid extract, enzymes, and a "new generation" non-ionic wetting agent. It will afford you extended planting and harvesting opportunities year round, more successful, healthier plantings, fewer warranty replacements, and greater customer satisfaction.

Some of the benefits include: reduced transplant stress, wilt and flagging. It speeds root establishment for larger fibrous root mass. The anti-oxidants and photosynthetic capacities are increased and the moisture retention is improved. Transplanting stabilization and maturity is accelerated, and health and vigor are increased. Plant decline and mortality is decreased. And you get more prolific flower blooms, more pristine foliage and more durable plants!

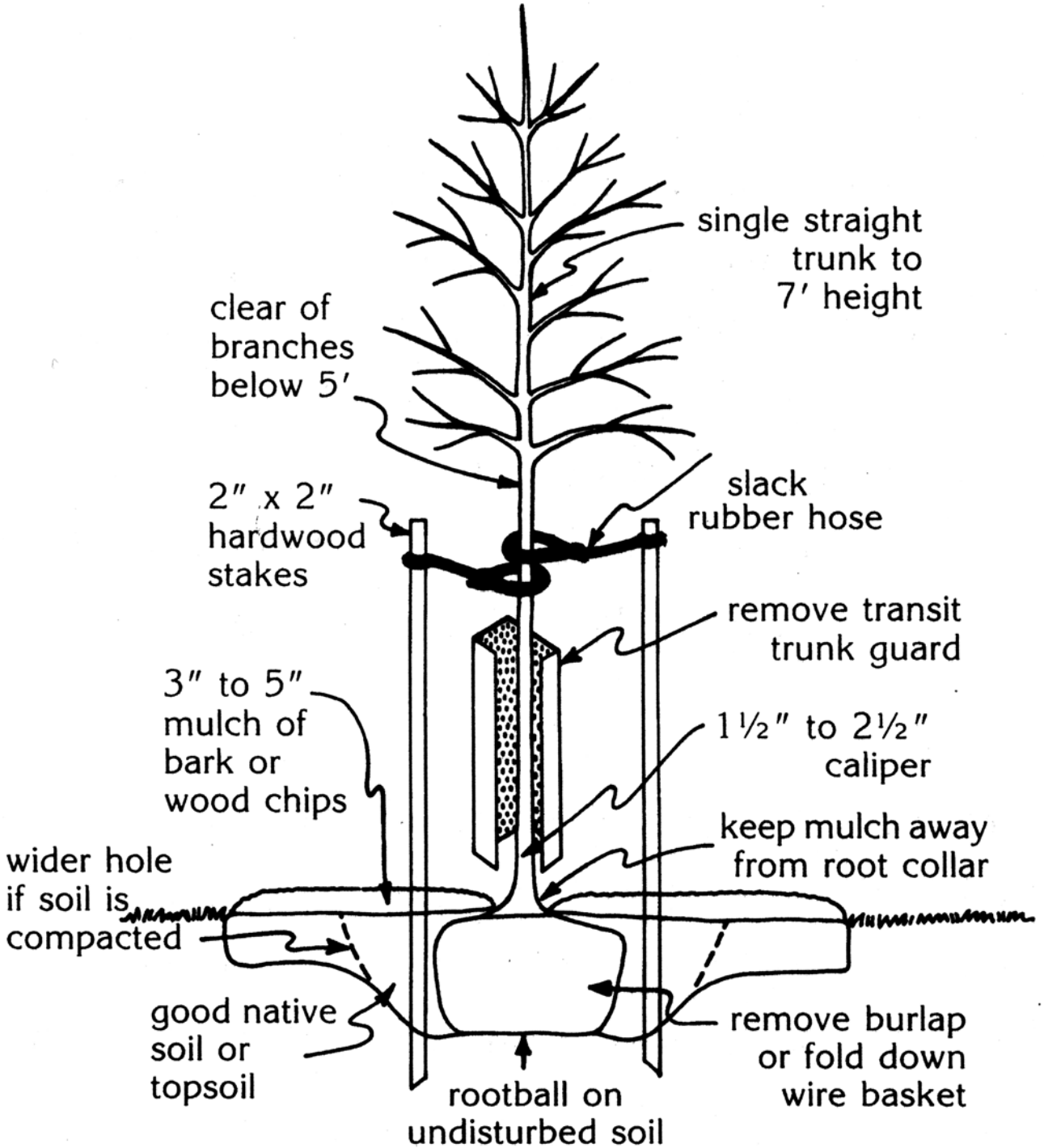
Great for professional applications such as: stress reduction and rooting on golf courses; summer digging for growers; transplanting and sodding; digging and B&B, and liners for nurseries; growth and root enhancers for greenhouses; root strike for propagators; and stress reduction and plant establishment for tree diggers. Call or write for a complete brochure.

Some Bio-Plex Research

- *2005.* Effects of bioplex on transplant success and recovery of summer-dug goldenraintree. *Journal of Env. Hort.*

- Bioplex applied before digging had no effect on growth after transplant.

- Bioplex reduced transpiration for 3-5 days after application, but had no long-term benefit on survival and regrowth of summer transplanted goldenraintrees.


single straight trunk to 7′ height
clear of branches below 5′
2″ x 2″ hardwood stakes
slack rubber hose
remove transit trunk guard
3″ to 5″ mulch of bark or wood chips
1½″ to 2½″ caliper
keep mulch away from root collar
wider hole if soil is compacted
good native soil or topsoil
remove burlap or fold down wire basket
rootball on undisturbed soil

DESIGN

Trees play a large part in landscape design.

Columnar or Fastigiate Branching - Ascending branches grow almost parallel to the main trunk. Trees are 4 to 5 times taller than spread.

Vase-Shaped Branching - No prominent leader, ascending branches growing straight. Spread normally would be approximate one half height of plant.

Conical Branching - Branching that forms a triangle with a strong vertical center being dominant.

Broad-Oval Branching - Ascending branching that forms a round head with equal spread and height.

Broad-Spreading Branching - No prominent leader. Main branches spread out to give as much spread as height in place.

Broad-Upright Branching - Trees with spreading ascending branches with a strong central leader. Mature spread

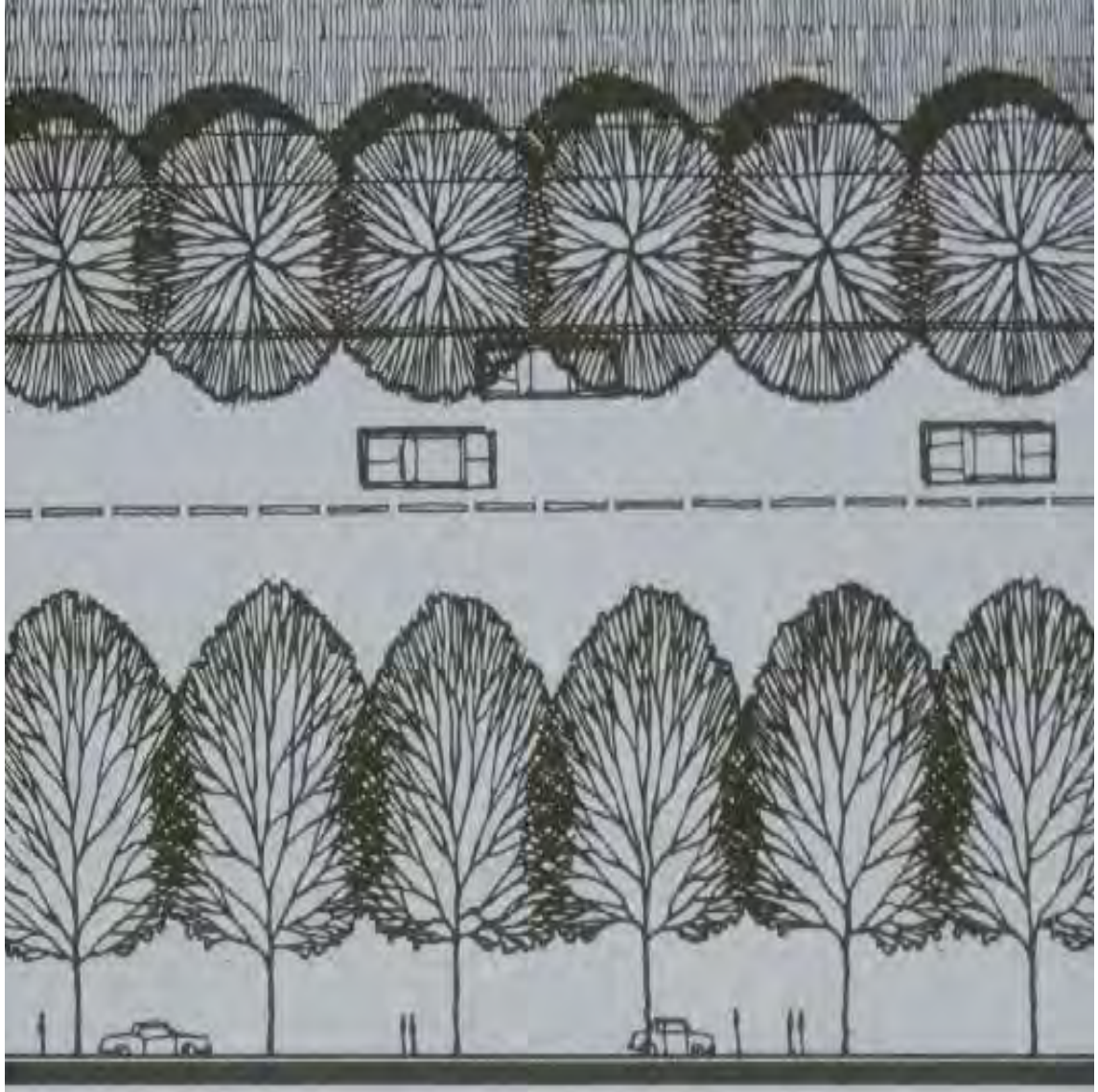
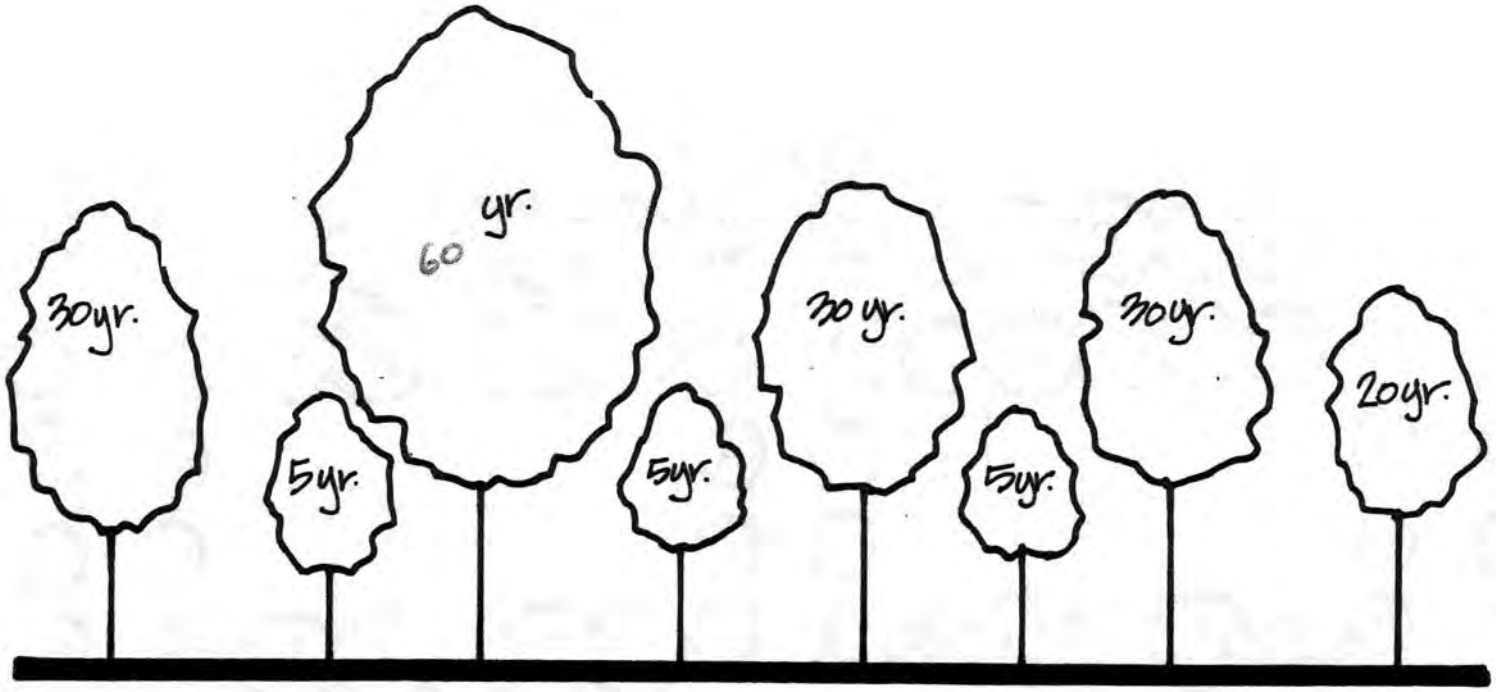


Figure 6-3. Formal Planting Concept – Large Trees

NO UNAUTHORIZED
VEHICLES BEYOND
THIS POINT

AGE AND SPECIES DIVERSITY



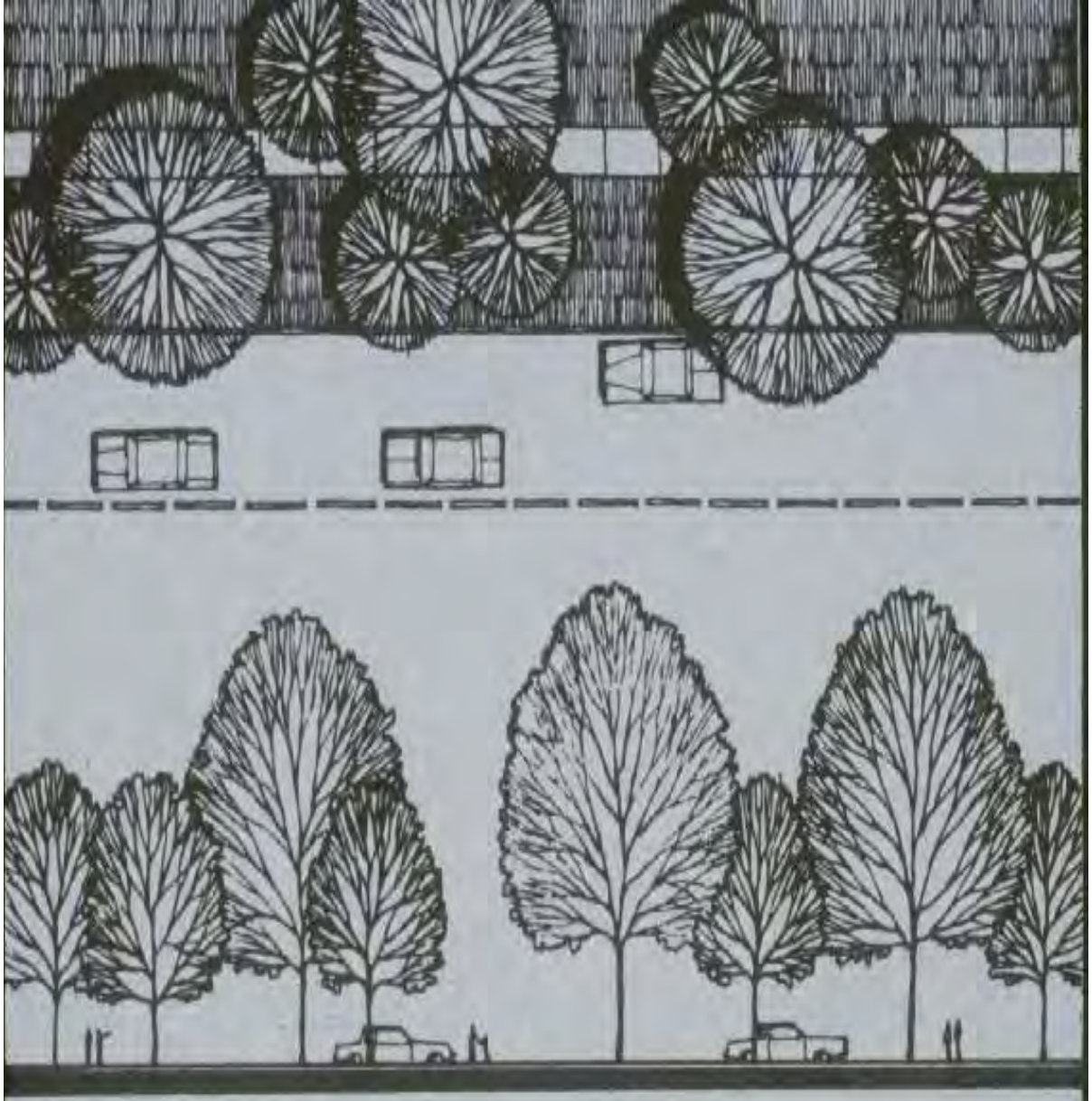
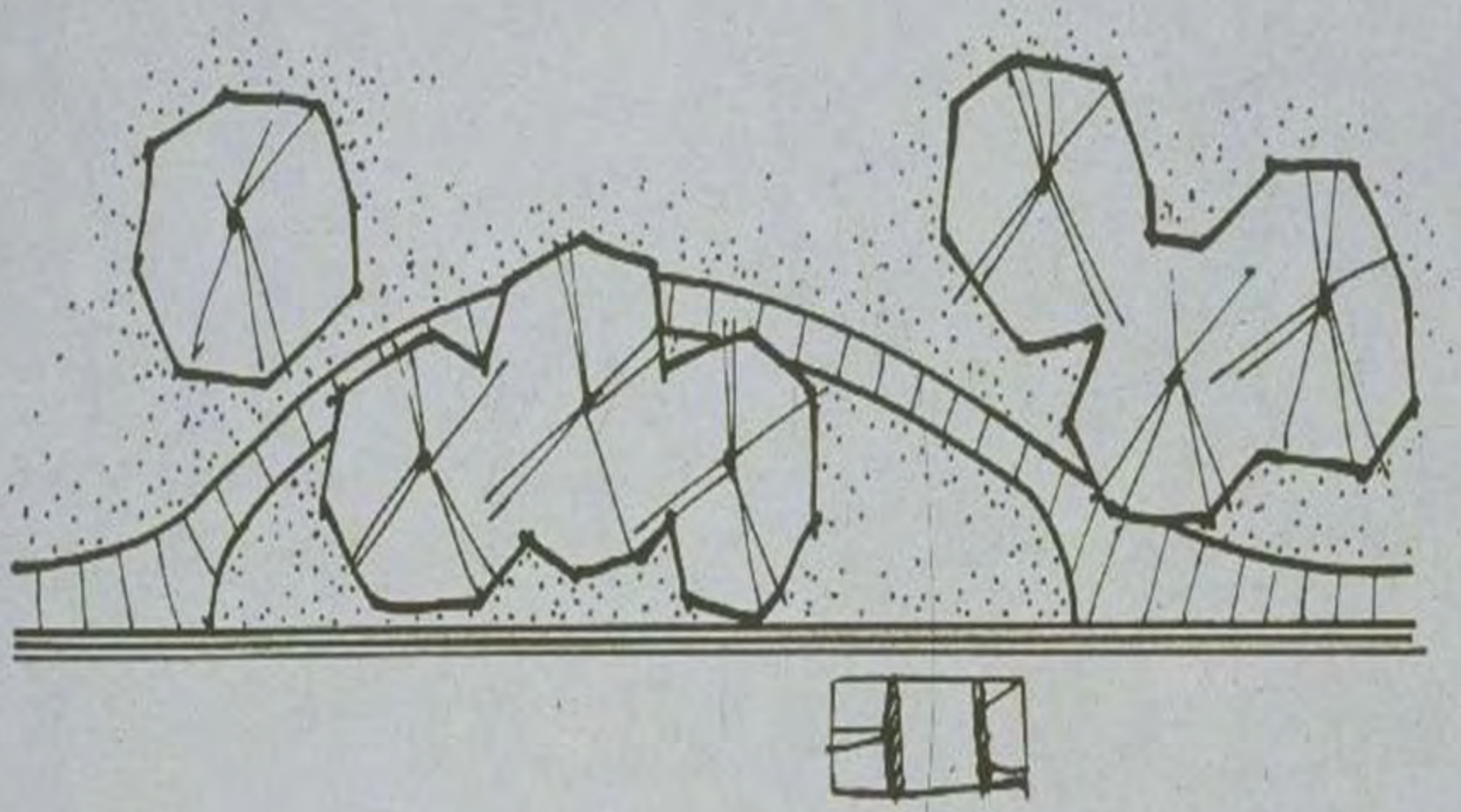
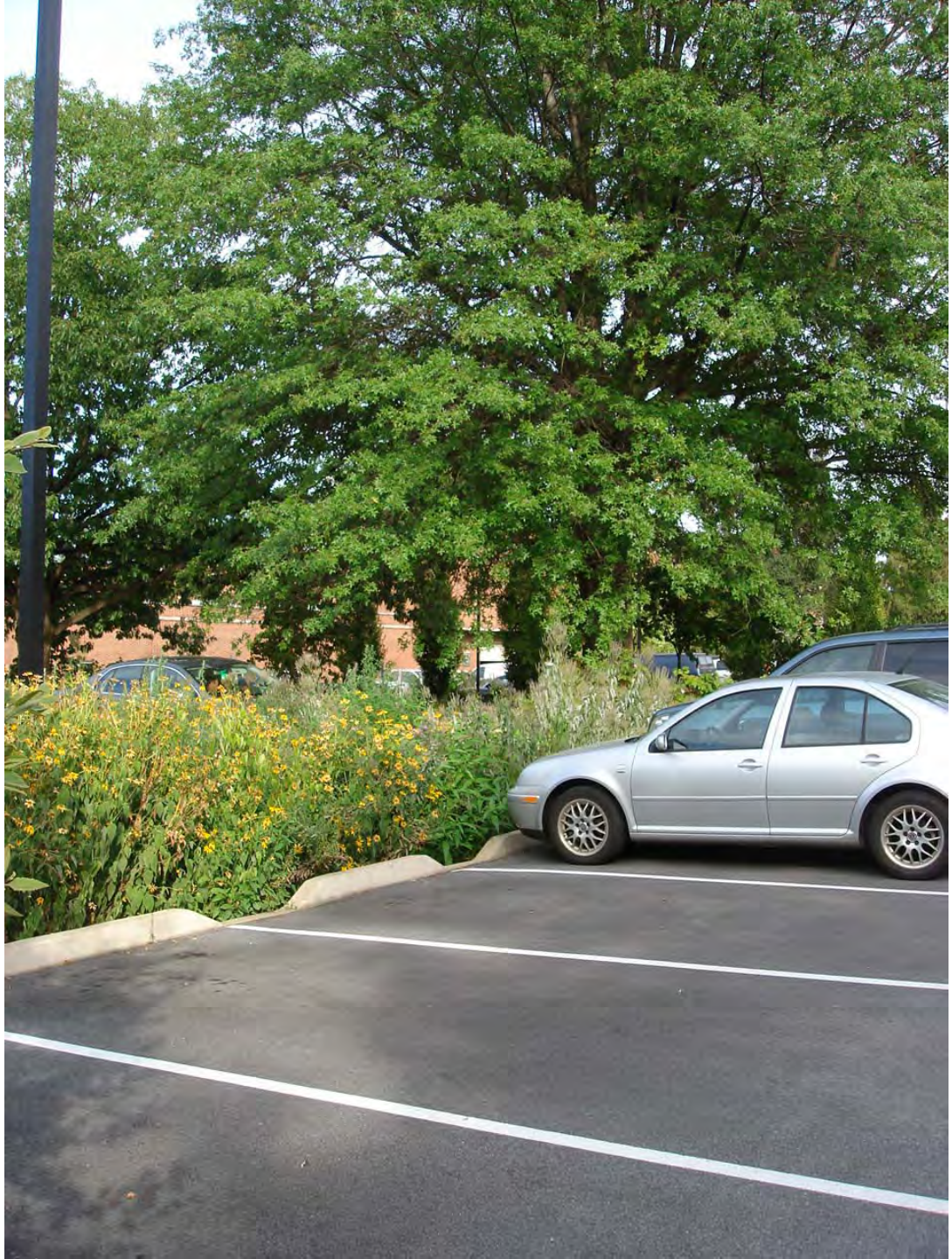


Figure 6-4. Informal Planting Concept — Mixed Tree Sizes



STORMWATER: EVAPOTRANSPIRATION AND INFILTRATION

PHOTO: TOM LIPTAN, PORTLAND, OR



LANDSCAPE DESIGN ORDINANCE

STORMWATER ORDINANCES

PRESERVE TREES PROPERLY

SHORTLIDGE RD
NORTH CLOSED
ACCESS TO
RITENOUR HALL

CONSERVATION SUBDIVISION

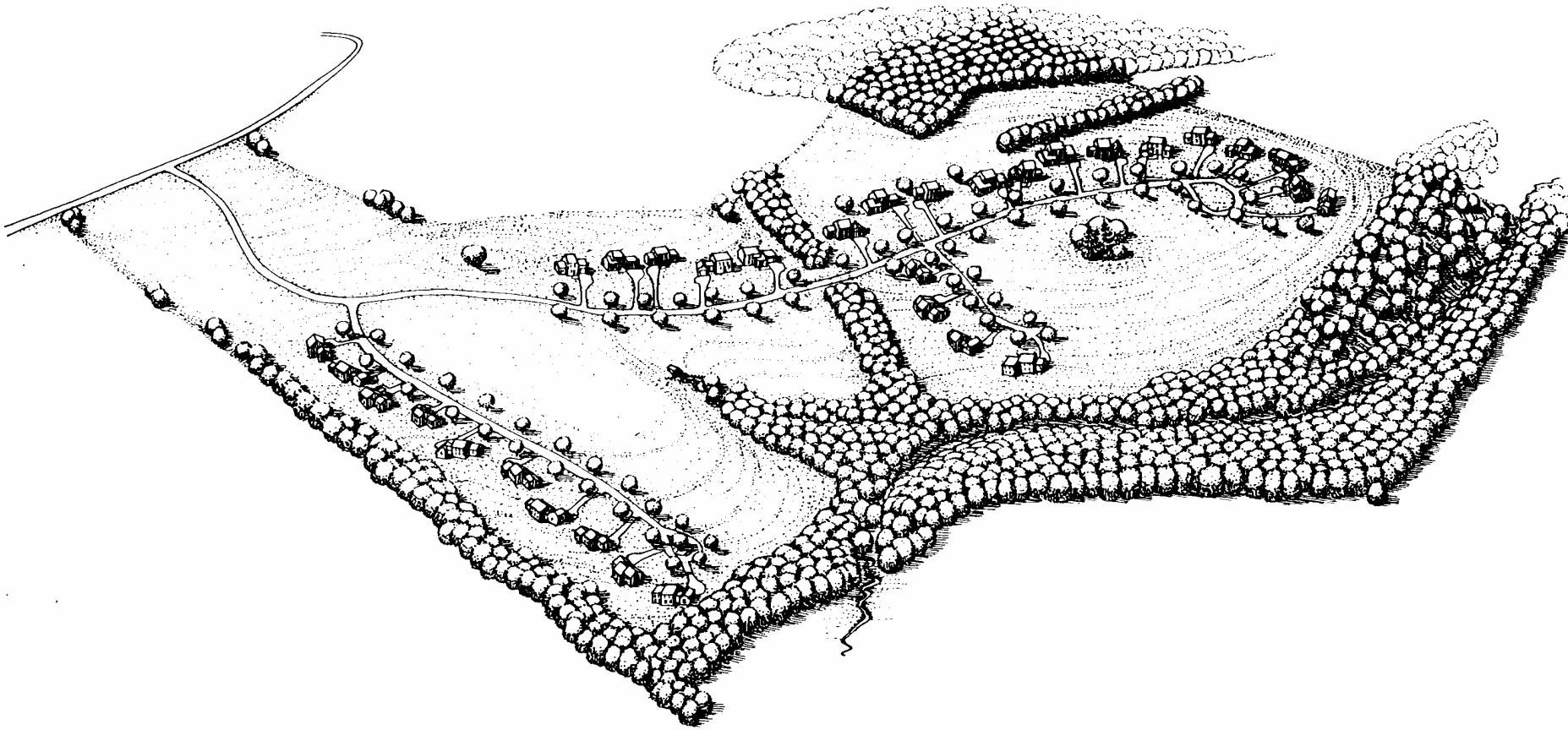


Fig. 7.1.10 Site A: *With Open Space Design*

TREES TO THINK ABOUT

American elm and varieties- Dutch elm disease and elm yellows

Ash- emerald ash borer

Little leaf linden- heat and drought/aphids

Norway maple- invasive/decay columns

Ornamental pear- invasive/poor branch structure

Pin and red oak- bacteria leaf scorch and oak wilt**

Silver maple- huge/poor structure

Sugar maple- salt/heat and drought/verticillium wilt**

Sycamore and flowering dogwood- anthracnose**

Turkish filbert- untimely mortality?

FAVORITE TREES

Bur oak- beautiful form, big yard for ultimate size

White oak and swamp white oak- beautiful form, big yard for ultimate size

Eastern white pine- a classic native not often planted in home landscapes

Tulip poplar- “Redwood of the East”, interesting flowers and form

American linden- adaptable, fast growing, interesting form

Kentucky coffee tree- adaptable, fast growing, good solar tree

Common hackberry- adaptable, attractive

125 native trees in Pennsylvania.

FAVORITE TREES

River birch- adaptable, attractive bark

Sassafras- fruits, fall color, and overall form for beauty and interest

Black gum- beautiful form and foliage

Serviceberry- attractive small tree for lots of any size

Redbud- attractive spring flowers, interesting form

TREES FOR DOWNTOWN

ginkgo

London plane tree

honeylocust

hardy rubber tree

hybred maple (silver/red)

zelkova

PLANTING PROBLEMS

POOR PLANTING

Many examples of poor planting.

Planted too deep and **lack of irrigation** are two of the largest killers.

Lot
4

LAWRENCE

Arbor Day Song
Tho you are small
You will be tall
So do not cry just grow
up and touch the sky
Lift your limbs up high
and touch the sun
Spread your branches out wide
and catch the rain
hear me sing you are
You are the wind
You are the

By 1984 there will be one million more trees in Los Angeles. **HELP PLANT THE URBAN FOREST.**

TREES AND SIDEWALKS

Proper tree size.

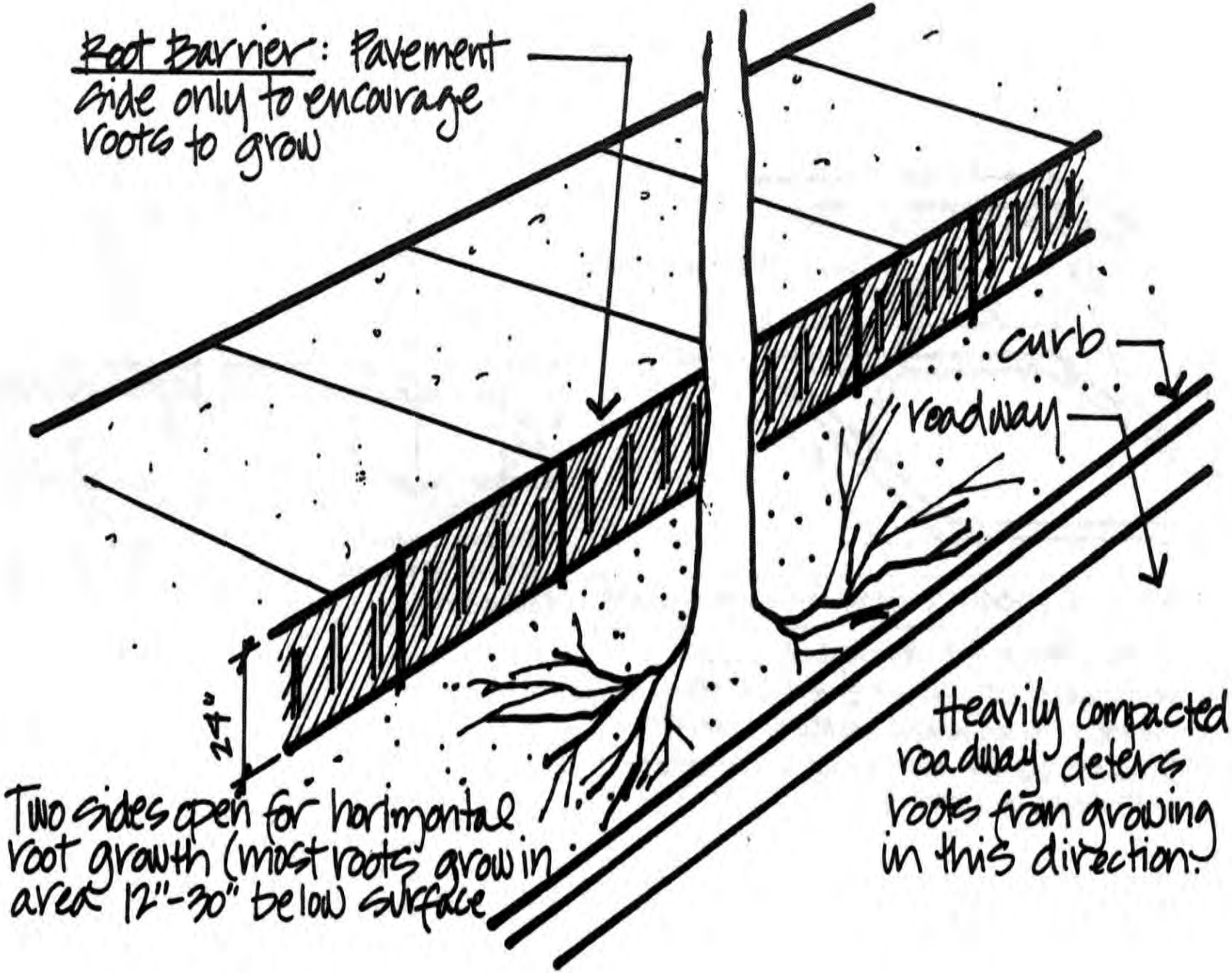
Proper site preparation.

Proper planting.

Proper care.

Root barriers.

DeepRoot
Barrier


Root Barrier: Pavement side only to encourage roots to grow
curb
roadway
24"
Heavily compacted roadway deters roots from growing in this direction.
Two sides open for horizontal root growth (most roots grow in area 12"-30" below surface

RUBBER SIDEWALK REPLACEMENTS

Rubber sidewalks bend with seasonal moisture variations and pressure from growing roots.

If a rubber sidewalk has to be removed due to street work, it can be reused and glued back into place.