American National Standard

for Tree Care Operations —

Tree, Shrub, and Other Woody Plant Management — Standard Practices (Soil Management a. Modification, b. Fertilization, and c. Drainage)

TCIA®
VOICE OF TREE CARE

Approved American National Standard
ANSI

ANSI A300 (Part 2)-2011 Soil Management
a. Modification, b. Fertilization, and c. Drainage
Revision of ANSI A300 (Part 2)-2004 Fertilization

ANSI A300 (Part 2)-2011
Soil Management a. Modification, b. Fertilization, and c. Drainage

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Secretariat
Tree Care Industry Association, Inc.

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American National Standard

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Contents

Foreword (This foreword is not part of the A300 Part 2 American National Standard)

ANSI A300 Standards are divided into multiple parts, each focusing on a specific aspect of woody plant management (e.g. Pruning, Soil Management, Supplemental Support Systems, etc).

These standards are used to develop written specifications for work assignments. They are not intended to be used as specifications in and of themselves. Management objectives may differ considerably and therefore must be specifically defined by the user. Specifications are then written to meet the established objectives and must include measurable criteria.

ANSI A300 standards apply to professionals who provide for, or supervise the management of, trees, shrubs, and other woody landscape plants. Intended users include businesses, government agencies, property owners, property managers, and utilities.

The standard does not apply to agriculture, horticultural production, or silviculture, except where explicitly noted otherwise. This standard was developed by the Tree Care Industry Association (TCIA), an ANSI-accredited Standards Developing Organization (SDO). TCIA is secretariat of the ANSI A300 standards, and develops standards using procedures accredited by the American National Standards Institute (ANSI).

Consensus for standards writing was developed by the Accredited Standards Committee on Tree, Shrub, and Other Woody Plant Management Operations – Standard Practices, A300 (ASC A300).

Prior to 1991, various industry associations and practitioners developed their own standards and recommendations for tree care practices. Recognizing the need for a standardized, scientific approach, green industry associations, government agencies and tree care companies agreed to develop consensus for an official American National Standard.

The results – ANSI A300 standards – unify and take authoritative precedence over all previously existing tree care industry standards. ANSI requires that approved standards be developed according to accepted principles, and that they be reviewed and, if necessary, revised every five years.

TCIA was accredited as a standards developing organization with ASC A300 as the consensus body on June 28, 1991. ASC A300 meets regularly to write new, and review and revise existing, ANSI A300 standards. The committee includes industry representatives with broad knowledge and technical expertise from residential and commercial tree care, utility, municipal and federal sectors, landscape and nursery industries, and other interested organizations.

Suggestions for improvement of this standard should be forwarded to: ANSI A300 Secretary, c/o Tree Care Industry Association, Inc., 136 Harvey Road - Suite 101, Londonderry, NH 03053.

ANSI A300 (Part 2)-2011 Soil Management a. Modification, b. Fertilization, and c. Drainage was approved as an American National Standard by ANSI on February 17, 2011. ANSI approval does not require unanimous approval by ASC A300.

(Continued)

The ASC A300 committee had the following members as of February 17, 2011:

Tim Johnson, Chair
(Artistic Arborist, Inc.)

Bob Rouse, Secretary
(Tree Care Industry Association, Inc.)

Organizations Represented	Name of Representative
Alliance for Community Trees	*Michael Galvin* *Alice Ewen (Alt.)*
American Nursery and Landscape Association	*Warren Quinn* *Craig J. Regelbrugge (Alt.)*
American Society of Consulting Arborists	*Jerry Pulley* *Stephen Miller (Alt.)*
American Society of Landscape Architects	*Ron Leighton*
Asplundh Tree Expert Company	*Geoff Kempter* *Peter Fengler (Alt.)*
Bartlett Tree Expert Company	*Peter Becker* *Dr. Thomas Smiley (Alt.)*
Davey Tree Expert Company	*Joseph Tommasi* *Grant Jones (Alt.)*
International Society of Arboriculture	*Bruce Hagen* *Sharon Lilly (Alt.)*
National Park Service	*Vacant (Robert DeFeo – Observer, designated voter)*
Professional Grounds Management Society	*Thomas Shaner*
Professional Land Care Network	*Bill Brinn*
Society of Municipal Arborists	*Gordon Mann* *Nolan Rundquist (Alt.)*
Tree Care Industry Association	*Dane Buell* *James McGuire (Alt.)*
USDA Forest Service	*Keith Cline* *Ed Macie (Alt.)*
Utility Arborist Association	*Matthew Simons* *William Rees (Alt.)*

Additional organizations and individuals:
Guy Meilleur-American Forests (Observer)
Peter Gerstenberger (Observer)
Sabeena Hickman (Observer)
Andy Hillman (Observer)
Myron Laible (Observer)
Beth Palys (Observer)
Richard Rathjens (Observer)
Mary Reynolds (Observer)
Richard Roux (NFPA-780 Liaison)
Don Zimar (Observer)

ASC A300 mission statement:

Mission: To develop consensus performance standards based on current research and sound practice for writing specifications to manage trees, shrubs, and other woody plants.

American National Standard for Tree Care Operations –

Tree, Shrub, and Other Woody Plant Management – Standard Practices *(Soil Management a. Modification, b. Fertilization, and c. Drainage)*

Subclauses 1.1 to 1.3 excerpted from ANSI A300 (Part 1) Pruning.

1 ANSI A300 standards

1.1 Scope

ANSI A300 standards present performance standards for the care and management of trees, shrubs, and other woody plants.

1.2 Purpose

ANSI A300 performance standards are intended for use by federal, state, municipal and private entities including arborists, property owners, property managers, and utilities for developing written specifications.

1.3 Application

ANSI A300 performance standards shall apply to any person or entity engaged in the management of trees, shrubs, or other woody plants.

10 Part 2 – Soil Management a. Modification, b. Fertilization, and c. Drainage standards

10.1 Purpose

The purpose of this clause is to provide standards for developing specifications for soil management, a. modification, b. fertilization, and c. drainage.

10.1.1 Soil management practices for agricultural, horticultural production, or silvicultural purposes are exempt from this standard unless this standard, or a portion thereof, is expressly referenced in standards for these other related areas.

10.2 Reason

10.2.1 The reason for soil management shall be to manage the physical, chemical, and/or biological properties of the soil to create and/or maintain favorable nutritional and soil conditions in the root zones of trees, shrubs, and other ornamental plants to meet an objective.

10.3 Implementation

10.3.1 Plant tolerance to existing soil conditions shall be considered before modifying soil conditions.

10.3.2 Specifications for soil management should be written and administered by an arborist or soil management professional.

10.3.3 Specifications for soil management should include location, objectives, site and soil evaluations, number of soil samples, materials, rate, application method(s), soil loosening method(s), treatment area, and timing.

10.3.4 Soil management specifications shall be adhered to.

10.4 Safety

10.4.1 This performance standard shall not take precedence over applicable industry safe work practices.

10.4.2 Soil management shall be performed by an arborist or soil management professional familiar with the practices and hazards of soil management and the equipment used in such operations.

10.4.3 Performance shall comply with applicable Federal and State Occupational Safety and Health Administration (OSHA) standards, ANSI Z133, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Federal Environmental Protection Agency (EPA) regulations as well as state and local regulations.

10.4.4 The sites shall be inspected for hazards prior to implementing any soil management operations within the root zones of trees and woody plants.

10.4.5 The location of utilities and other obstructions both below and above ground shall be taken into consideration prior to soil management operations. Utilities and other obstructions include, but are not limited to, gas, electric, communications, sewer, drainage, and signage.

11 Normative references

The following standards contain provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI Z117.1, Safety Requirements for Confined Spaces

ANSI Z133, *Arboriculture – Safety requirements*

29 CFR 1910, General industry[1]

29 CFR 1910.268, Telecommunications[1]

29 CFR 1910.146, Permit-required Confined Spaces (PRCS)[1]

29 CFR 1910.269, Electric power generation, transmission, and distribution[1]

29 CFR 1910.331 - 335, Electrical safety-related work practices[1]

29 CFR 1926.650, Trenching and Excavation[1]

[1] Available from U.S. Department of Labor, 200 Constitution Ave., NW, Washington, DC 20210.

12 Definitions (Definitions are part of the ANSI A300 Part 2 standard)

12.1 arborist: An individual engaged in the profession of arboriculture who, through experience, education and related training, possesses the competence to provide for, or supervise the management of, trees and other woody ornamentals.

12.2 arborist trainee: An individual undergoing on-the-job training to obtain the experience and the competence required to provide for, or supervise the management of, trees and woody plants. Such trainees shall be under the direct supervision of an arborist.

12.3 available water: Water remaining in the soil after gravitational water held within soil macropores has drained and before the permanent wilting point is reached.

12.4 buffering capacity: The ability of the soil to maintain or resist change in pH.

12.5 bulk density: Mass of dried soil per unit volume (g/cc3); often used as a measure of soil compaction.

12.6 compacted soil: A high density soil lacking structure and porosity characterized by restricted water infiltration and percolation (drainage), and limited root penetration.

12.7 dripline: The soil surface delineated by the branch spread of a single plant or group of plants.

12.8 fertilization: The application of fertilizer to the soil or plant.

12.9 fertilizer: A material containing one or more of the elements essential for plant growth, development, or reproduction.

12.9.1 fertilizer, organic: A fertilizer containing carbon and one or more elements other than hydrogen and oxygen, essential for plant growth, development, or reproduction.

12.9.2 fertilizer, natural inorganic: A fertilizer that exists in or is produced by nature and may be altered from its original state by physical manipulation.

12.9.3 fertilizer, natural organic: An organic fertilizer derived from either plant or animal products containing one or more elements essential for plant growth. These materials may be subjected to biological degradation.

12.9.4 fertilizer, synthetic organic: An organic fertilizer that is man-made.

12.10 fertilizer analysis: The composition of a fertilizer expressed as a percentage by weight of total nitrogen (N), available phosphoric acid (P_2O_5), soluble potash (K_2O), and other nutrients.

12.11 fertilizer ratio: The ratio of total nitrogen (N), available phosphoric acid (P_2O_5), and soluble potash (K_2O); e.g., the ratio of a 30-10-10 fertilizer is 3:1:1.

12.12 field capacity: The maximum water content of a soil after drainage due to the force of gravity.

12.13 fill soil: Soil placed over the existing soil surface to raise the finished grade to some specified level.

12.14 French drain: A trench filled with gravel or rock that may contain perforated pipe to direct surface or ground water away from an area.

12.15 geotextile fabric: A woven blanket manufactured from synthetic fibers.

12.16 gravitational water: Water that drains from larger soil pores (macropores) due to the force of gravity.

12.17 hand-digging: Careful soil excavation using 'hand-tools' to expose roots for inspection or to determine where mechanical excavation can be done without causing significant root damage or loss.

12.18 hydraulic soil excavation: The removal of soil using pressurized water to minimize root damage.

12.19 impenetrable layer: Full or partial obstructions such as hardpans, plow pans, rock, abrupt textural changes, or retaining walls that restrict drainage.

12.20 implant: A capsule or other device permanently inserted into the xylem.

12.21 infiltration: The entry of water into a soil.

12.22 minimally injurious soil excavation: Method to remove soil around woody roots that minimizes bark injury, such as manual, hydraulic, pneumatic, or tunneling.

12.23 mulch: A material applied to the soil surface to protect the soil, deter erosion, moderate soil temperature, conserve moisture, inhibit weeds and improve soil structure.

12.24 nutrient: Element or compound required for growth, reproduction, or development of a plant.

12.24.1 macronutrient: Nutrient required in relatively large amounts by plants, such as nitrogen (N), phosphorus (P), potassium (K), and sulfur (S).

12.24.2 secondary nutrient: Nutrient required in moderate amounts by plants, such as calcium (Ca) and magnesium (Mg).

12.24.3 micronutrient: Nutrient required in relatively small amounts by plants, such as iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), and boron (B).

12.25 organic layer: The layer of decomposed, decomposing, and other organic material above the mineral topsoil.

12.26 percolation: The movement of free water through the soil profile.

12.27 permanent wilting point: The point at which plant roots can no longer absorb water from the soil.

12.28 permeability: The ease with which water penetrates and passes through the soil profile.

12.29 pneumatic soil excavation: The removal of soil using pressurized air to minimize root damage.

12.30 quick-release fertilizer: A fertilizer

that is immediately available to the plant.

12.31 salt index: A measure of the salt concentration that fertilizer produces in the soil solution. The higher the salt index, the more likely that plant damage will occur.

12.32 saturated soil: A soil condition where all of the pores (micropores and macropores) are filled with water.

12.33 shall: As used in this standard, denotes a mandatory requirement.

12.34 should: As used in this standard, denotes an advisory recommendation.

12.35 slow-release fertilizer: A fertilizer containing plant nutrients in a form that delays availability for plant uptake and use after application, or that extends availability to the plant.

12.36 soil aeration: The process of improving air exchange in the soil.

12.37 soil amendment: A material incorporated into the soil that improves physical characteristics.

12.38 soil modification: Physically or chemically altering soils to improve conditions.

12.39 soil pH: The relative acidity or alkalinity of soil; technically, pH is the negative log of the hydrogen ion concentration.

12.40 soil salinity: The measure of the concentration of mineral ions dissolved in soil solution (water).

12.41 soil structure: Soil classification characteristic of how soil particles clump or bind together (aggregate), creating voids between the aggregates.

12.42 soil texture: Soil classification characteristic of the relative size (fineness or coarseness) of soil mineral particles, specifically the proportions of sand, silt, and clay.

12.43 soil volume: The volume of soil available to trees and other woody plants for root development.

12.44 specifications: A detailed, measurable plan or proposal for performing a work activity or providing a product; usually a written document.

12.45 standard, ANSI A300: The performance parameters established by industry consensus as a rule for the measure of extent, quality, quantity, value or weight used to write specifications.

12.46 subsurface application: The application of a material below the soil surface.

12.47 surface application: The application of a material to the soil surface, mulch or ground cover.

12.48 topography: The physical relief or terrain, such as hills, ridges, swales, drainage, slope and aspect – that influence water movement and drainage, soil depth, soil moisture content, exposure to sunlight, wind, and other factors.

12.49 trunk injection: A technique to introduce a liquid material directly into the xylem.

12.50 water-insoluble nitrogen (WIN): Nitrogen not readily soluble in cold water.

12.51 wood-chip mulch: A material placed on the soil surface composed of ground wood, bark and leaves usually generated by sending tree parts through a wood chipping machine.

13 Soil management

13.1 Objectives

13.1.1 Soil management objectives shall be established.

13.1.2 Soil management objectives shall include, but are not limited to, one or more of the following:

- Promoting plant health, increasing growth, and improving appearance;
- Enhancing root function and development;
- Preventing or mitigating soil conditions unfavorable for root growth;
- Reducing soil erosion and compaction;
- Enhancing soil biological diversity;

Managing soil moisture;
Managing soil nutrients;
Promoting plant establishment and long-term survival;
Managing plant pests; and,
Inhibiting competitive vegetation.

13.2 General

13.2.1 Soil management practices should include, but are not limited to, one or more of the following:
Soil conditions assessment;
Mulching;
Tilling (cultivation);
Adding amendments to alter soil conditions;
Fertilization;
Moisture management; and,
Drainage improvement.

13.2.2 Soil management material safety precautions shall be followed for all products.

13.2.3 Materials shall be used in accordance with federal, state, and local regulations.

13.2.4 To achieve the defined objective, site factors shall be considered, including proximity to waterways, past soil management practices, slope, and irrigation.

13.2.5 Applications of materials to adjust the soil pH shall be considered.

13.2.6 Plant conditions such as disease, insect infestations, and herbicide damage shall be considered.

13.2.7 Soil modification to improve nutrient uptake shall be considered prior to fertilization.

13.2.8 Practices that reduce natural leaf litter accumulation within the root zones of plants should be avoided.

14 Soil management a. soil modification

14.1 Soil modification objectives shall be established.

14.2 Soil modification objectives shall include, but are not limited to, one or more of the following:
Protecting roots;
Improve soil conditions to enhance root development; and,
Maintain or enhance tree health.

14.3 Soil modification shall include one or more of the following:
Evaluating site soil conditions;
Managing soil organic matter content; and,
Prevention and mitigation of soil compaction.

14.4 Evaluating site soil condition practices

14.4.1 Site and soil evaluation objectives shall be established.

14.4.2 Site and soil evaluation items should include, but are not limited to, the following:
Site topography – surface drainage;
Soil drainage (infiltration and percolation);
Soil texture;
Soil profile;
Bulk density;
Salts;
Soil depth;
Presence of impermeable layers and height of water table; and,
Organic matter levels.

14.4.3 Soil and site physical characteristics should be assessed prior to designing, plant selection, planting, and/or developing management plans for landscapes.

14.4.4 Soil testing should be done prior to designing, plant selection, planting, and/or developing management plans for landscapes.

14.4.5 The number of samples to be collected should be specified and should be representative of the site, see **Annex B**.

14.5 Managing soil organic matter content practices

14.5.1 Soil organic matter content management objectives shall be established.

14.5.2 Soil organic matter objectives shall

include, but are not limited to:
- Maintaining soil organic matter at an adequate level for the plant species at the site;
- Improving moisture holding capacity;
- Improving aeration;
- Managing disease; and,
- Managing cation exchange capacity (CEC).

14.5.3 Soil organic matter should be maintained within a specified target range adjusted for tree species and regional variation.

14.5.4 If soil organic matter content is low, composted organic materials should be incorporated into the soil or applied to the surface as mulch.

14.6 Incorporation of soil amendments

14.6.1 Soil amendments specified should be appropriate for the chemical and physical characteristics of the site soil and to meet the objective.

14.6.2 Organic matter shall be incorporated uniformly into the soil.

14.6.3 When recurring compaction is a concern, amendments based on soil texture shall be specified to meet objectives.

14.6.4 Non-composted woody materials shall be avoided when incorporating into the soil.

14.6.5 Composts, when used as soil amendments, should be tested by a qualified lab for chemical properties, such as pH and salt index.

14.6.6 Compost composition and properties, depth, and area of incorporation into the soil shall be specified.

14.6.7 Soil amendments should be incorporated into the soil during mechanical loosening of the soil.

14.6.8 Soil amendments should be incorporated throughout the specified area.

14.6.9 Sand should not be used as a soil amendment for clayey soils unless it will exceed 50 percent of the soil volume.

14.6.10 Gypsum should not be used as an amendment for mitigation of soil compaction.

14.7 Compaction – prevention and mitigation practices

14.7.1 Prevention and mitigation of soil compaction objectives shall be established.

14.7.2 Prevention and mitigation of soil compaction objectives should include, but are not limited to, one or more of the following:
- Maintain or improve soil aeration;
- Maintain or increase water penetration (infiltration rate) and percolation;
- Maintain or enhance water-holding capacity and drainage;
- Maintain or improve ease of root penetration; and,
- Maintain or reduce surface runoff and soil erosion.

14.7.3 Methods to mitigate compacted soils shall be specified. Methods include, but are not limited to:
- Mulching;
- Incorporation of soil amendments;
- Mechanical loosening (cultivation); and,
- Loosening using high pressure air.

14.7.4 Soil bulk density should be maintained between 1.1 to 1.4 g/cc3, not to exceed 1.6 g/cc3.

14.7.5 Measures should be taken to prevent or minimize soil compaction while working within the root zones of trees and woody plants or where landscapes are planned.

14.7.6 Activities on wet soils should be avoided or preventative actions shall be taken to avoid compaction.

14.7.7 Soils with surface compaction in areas where landscape plantings are planned should be amended with organic matter following mechanical loosening to the depth specified.

14.7.8 Mulching should be considered a long term method to treat moderately compacted soil within the root zones of trees and woody plants.

14.7.9 Mechanical soil loosening

14.7.9.1 Compacted soil should be mechanically loosened before adding topsoil.

14.7.9.2 The depth of the compacted layer to be loosened shall be specified.

14.7.9.3 Pneumatic soil loosening should be considered the preferred method to mitigate compacted soil within the root zones of plants.

14.7.9.4 Compacted soils should be moist before being loosened using pneumatic excavation tools.

14.7.9.5 Moisture content of compacted soil should be less than field capacity before being mechanically tilled.

14.7.9.6 Under existing plants, compacted soils should be loosened using the least injurious method to meet the objective.

14.7.9.7 Under existing plants, when mechanical loosening of the soil is impractical, organic mulch should be applied to mitigate compaction in time.

14.7.9.8 Under existing plants, compacted soil should be remediated within the affected root zone area using methods that minimize injury to roots. Remediation includes one or more of the following:

Loosening;
Amending; and,
Replacing.

14.7.10 Surface application of organic mulch

14.7.10.1 Mulching objectives shall be established.

14.7.10.2 Mulching objectives should include but are not limited to one or more of the following:

Inhibiting weed growth;
Conserving soil moisture;
Moderating soil temperature extremes;
Preventing and alleviating soil compaction;
Preventing soil erosion and surface crusting;
Improving the soil structure and fertility;
Encouraging beneficial soil microorganisms;
Inhibiting certain root pathogens; and,
Increasing root growth and plant vigor.

14.7.10.3 Types of mulch and methods of application shall be specified to meet the objective.

14.7.10.4 When selecting the type of mulch, consideration should be given to tree species, soil conditions, irrigation practices, and pathogenic fungi.

14.7.10.5 Fresh or partially composted coarse [greater than ¾ inch (18 mm) average wood particle size] wood-chip mulch from trees should be preferred when the objective is to improve soil structure and enhance soil biological activity.

14.7.10.6 Fresh wood-chip mulch that is known to cause an allelopathic response in the plants being mulched, to be contaminated by a transmittable disease, or to contain seeds of undesirable plant species should be avoided.

14.7.10.7 The ignitability of mulches shall be considered.

14.7.10.8 Impervious plastic sheeting shall not be placed under the mulch.

14.7.10.9 Pervious fabric or sheeting should not be used under the mulch when the objective is to improve soil structure and increase organic matter content.

14.7.10.10 Mulch shall not be placed against tree trunks.

14.7.10.11 Mulch should be applied over as much of the root zone as practical.

14.7.10.12 Mulch should be applied and maintained at a depth of 2-4 inches (5-10 cm).

15 Soil management b. fertilization

15.1 Fertilization objectives shall be established.

15.2 Soil and/or foliar nutrient analysis should be used to determine the need, formulation, and rate of fertilizer.

15.3 The formulation and rate of fertilizer, timing and method of application, and treatment area shall be specified.

15.4 Soil pH shall be considered when selecting the fertilizer.

15.5 When fertilizing new transplants and plants sensitive to salt, a slow-release fertilizer should be used.

15.6 Soil reaction (pH) adjustment

15.6.1 The objectives for adjusting soil pH shall be established.

15.6.2 Soil pH should be determined prior to adjusting.

15.6.2.1 When a field test for soil pH is performed, it should be determined using a pH meter with a glass electrode following manufacturers' instructions.

15.6.2.2 Soil pH testing methods should follow the guidelines in **Annex B.**

15.6.3 When new plants are specified, they should be tolerant of the native soil pH.

15.6.4 Soil pH in landscapes with recognized pH problems should be monitored and treated periodically to meet the objective.

15.6.5 When pH adjustments are specified for new plantings, they should be performed prior to plant installation.

15.6.6 Elemental sulfur or sulfur-containing compounds should be the preferred material to lower pH.

15.6.7 Ground agricultural limestone (calcium carbonate) should be the preferred material to raise pH.

15.6.8 Application rates shall be determined based on the objective and soil pH.

15.6.8.1 Applications rates should be adjusted to avoid phytotoxicity.

15.6.9 Soil incorporation or injection should be the preferred methods to apply the materials.

15.6.10 The materials selected to adjust pH should be incorporated or injected into the upper 2 to 8 inches (5 to 20 cm) of the soil.

15.6.11 Adjusting pH in calcareous soil, those containing free calcium carbonate, should be considered impractical.

15.6.12 The soil pH should be determined every 3 to 5 years and adjusted as necessary.

15.7 Fertilizer applications

15.7.1 When to fertilize

15.7.1.1 Applications should be timed to meet management objectives.

15.7.2 Fertilizer formulations and rates

15.7.2.1 Fertilizer formulation should be adjusted based on objectives, condition and age of the plant, local knowledge, nutrient analysis, site conditions, and/or species.

15.7.2.2 The amount of water insoluble nitrogen (WIN) shall be considered.

15.7.2.3 Slow-release fertilizers with a minimum 50 percent WIN should be preferred.

15.7.2.4 Fertilizers with a salt index of less than 50 should be preferred.

15.7.2.5 Fertilizer formulations and rates in the absence of nutrient analysis

15.7.2.5.1 Fertilizers with higher ratios of P_2O_5 and K_2O should be avoided with the exception of palms.

15.7.2.5.2 Slow-release fertilizers should be applied at rates between 2 and 4 pounds of actual nitrogen per 1000 ft² (1 to 2 kg N/100 m²) per application and should not exceed 6 pounds of actual nitrogen per 1000 ft² (2.9 kg N/100 m²) within 12 months.

15.7.2.5.3 Quick-release fertilizers should be applied at rates between 1 and 2 pounds of actual nitrogen per 1000 ft² (0.5 to 1 kg N/100 m²) per application and shall not exceed 4 pounds actual nitrogen per 1000 ft² (2 kg N/100 m²) every 12 months.

15.7.3 Treatment area

15.7.3.1 The treatment area shall be defined prior to application. Consideration shall be given to root accessibility, root location, fertilization objectives, plant species, and site considerations.

15.7.3.2 For most trees and shrubs, the treatment area should be from near the trunk to near or just beyond the drip line. Inaccessible surfaces shall not be included in the rate calculation.

15.7.3.3 For fastigiate trees and unusual situations, the method for determining the treatment radius should be calculated by multiplying the plant's stem diameter at 4½ feet (1.4 m) above ground, measured in inches (cm), by 1 to 1½ (0.12 to 0.18) to determine the radius, expressed in feet (m), from the trunk of the plant.

For example, a 15-inch (38.1 cm) DSH (DBH) tree would have a fertilization area radius of 15 to 23 feet (4.6 to 6.9 m).

15.7.4 Surface application

15.7.4.1 Where turf, mulch, or ground covers exist, subsurface fertilization should be the preferred method of fertilization.

15.7.4.2 Precipitation and irrigation methods should be considered.

15.7.4.3 Fertilizer shall be uniformly distributed within the defined treatment area.

15.7.4.4 Surface applied fertilizers shall be watered in.

15.7.4.4.1 The watering-in period should be specified based on the objective and the material used.

15.7.4.5 Surface application shall not be made where surface runoff is likely to occur.

15.7.5 Sub-surface dry fertilization

15.7.5.1 Damage to the buttress roots should be avoided.

15.7.5.2 Holes shall be evenly spaced within the defined treatment area.

15.7.5.3 Hole depth, diameter, and spacing shall be specified. Holes should be 2 to 4 inches (5 to 10 cm) in diameter, spaced 12 to 36 inches (30 to 91 cm) apart, and 4 to 8 (10 to 20 cm) inches deep, and filled no closer than 2 inches (5 cm) from the soil surface.

15.7.5.3.1 The fertilizer shall be evenly distributed among the holes.

15.7.6 Sub-surface liquid fertilizer injection

15.7.6.1 Damage to the buttress roots should be avoided.

15.7.6.2 Injection sites shall be evenly spaced within the defined treatment area.

15.7.6.3 Injection site spacing and depth shall be specified. Injection sites should be 12 to 36 inches (30 to 91 cm) apart, and 4 to 8 inches (10 to 20 cm) deep, not to exceed 12 inches (30 cm) deep.

15.7.6.4 Fertilizer shall be evenly distributed among the injection sites.

15.7.7 Alternative fertilization techniques

15.7.7.1 All products shall be used in accordance with manufacturers' recommendations.

15.7.7.2 Foliar applications, trunk injections, or implants shall be used only when soil application of fertilizer is impractical or ineffective in achieving fertilization objectives. Fertilizer specified shall be formulated for the application method.

15.7.7.3 Hardness, pH, and salinity of the water used for the fertilizer solution should be considered.

15.7.7.4 When applying foliar fertilizer, the

fertilizer solution should be sprayed to thoroughly cover the foliage at the proper stage of growth to achieve fertilization objectives.

15.7.7.5 Injections and implants

15.7.7.5.1 Timing of injection/implant application should be at the proper growth stage to achieve fertilization objectives.

15.7.7.5.2 Products should be applied in the root flare or as low as practical in the trunk.

15.7.7.5.3 Holes shall be made as small and shallow as practical.

15.7.7.5.4 Application intervals should be timed to optimize results with minimal negative effect to the plant.

15.7.7.5.5 Small diameter trees and drought-stressed trees should not be treated with injections or implants.

15.7.7.5.6 A sharp bit, tip, or needle shall be used to create injection/implant sites.

16 Soil management c. drainage

16.1 Soil drainage management objectives shall be established.

16.2 Soil drainage management objectives should include, but are not limited to, one or more of the following:

Preventing environmental stress on plants;
Managing disease problems;
Promoting plant growth;
Mitigating plant damage from human activity;
Improving plant aesthetics;
Increasing fire-resistance;
Preventing excess water from collecting within the root zones of plants;
Improving soil aeration;
Managing subsurface water flow; and,
Managing surface water flow.

16.3 General

16.3.1 Measures to manage soil moisture and mitigate drainage problems should include, but are not limited to, one or more of the following:

Reduction of soil compaction;
Mitigation of impermeable layers (deep cultivation);
Grade changes;
Swales;
Ditches; and,
Installation of drains, sumps.

16.3.2 Soil drainage improvement should be considered most practical when done as a treatment prior to plant installation.

16.3.3 Where drainage is restricted, and it is not practical to mitigate the conditions, species tolerant of wet soils should be selected.

16.3.4 When improving drainage is not practical, planting on soil mounds or berms should be considered.

16.3.5 Drainage systems should be installed through or behind retaining walls to prevent water from impounding behind the walls.

16.3.6 Drain systems shall have sufficient slope to achieve the objective.

16.3.7 Planting containers shall have adequate drainage to remove excess water.

16.4 Mitigation of impenetrable layers

16.4.1 Impenetrable layers that restrict drainage, limit aeration, or impound water should be mitigated.

16.4.2 When practical, impenetrable layers should be disrupted by subsoil plowing or ripping prior to planting.

16.4.3 Auguring holes through impermeable layers to improve drainage around existing plants, and areas that cannot be disrupted by conventional means, should be considered.

16.4.4 Drain systems should be considered in areas where impeded drainage will adversely affect soil aeration in existing or planned landscapes.

16.5 Mitigation/adjustment of surface drainage

16.5.1 Surface drains (French drains, swales, ditches, culverts, berms, etc.) to prevent water from collecting around trees or in landscaped areas if drainage is slow or impeded should be considered.

16.6 Mitigation/adjustment of subsurface drainage

16.6.1 Subsurface drainage should be installed in sites where drainage is slow, the water table is close to the surface, or water is impounded by retaining walls, foundations, etc.

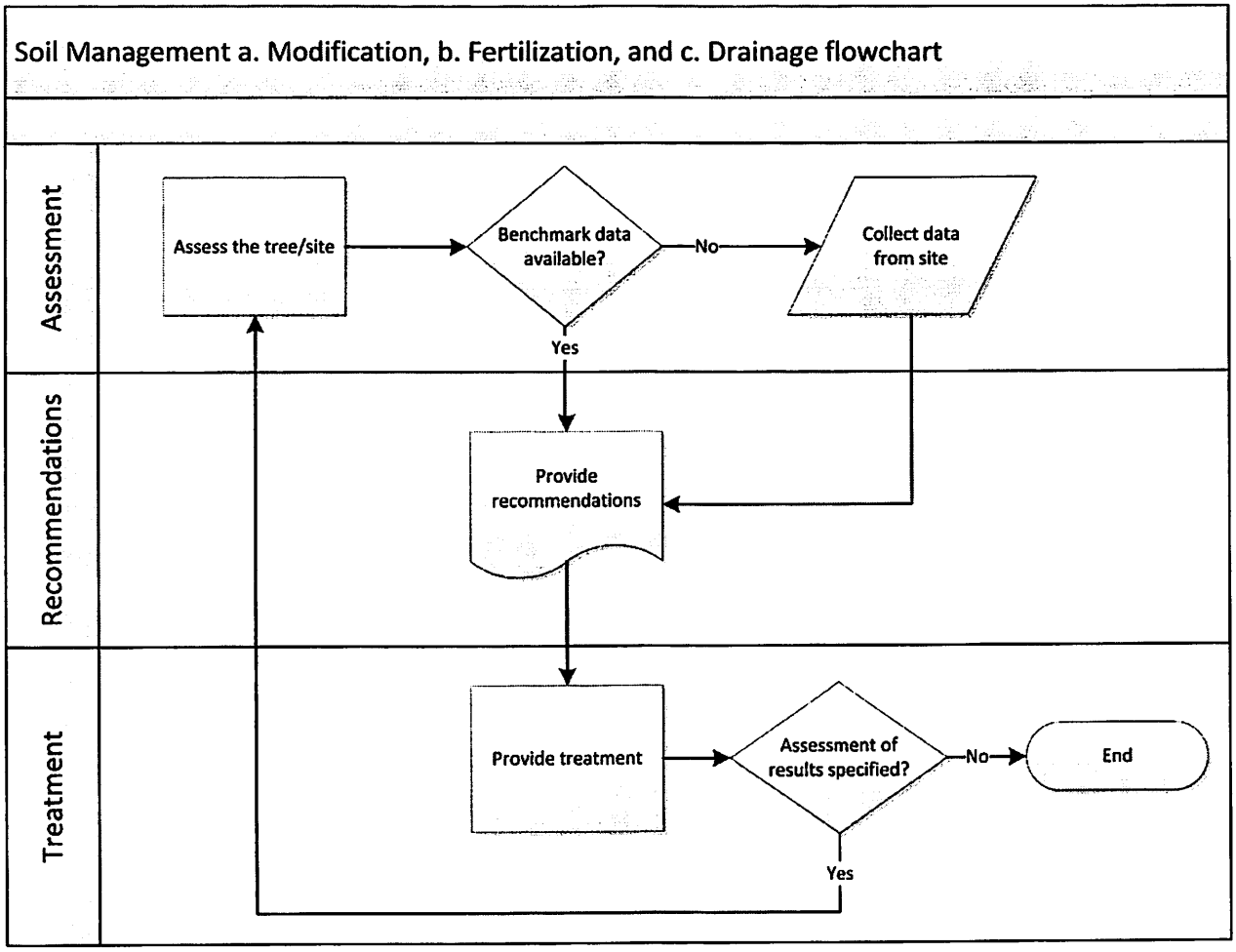
16.6.2 Subsurface drains should be installed to an adequate depth to meet the objective.

16.6.3 The subsurface drain type (French drains, perforated pipes, etc.) and design shall be specified.

16.6.4 French drains should be excavated to the depth needed to ensure favorable root zone conditions and be filled with coarse, uniform-sized gravel.

16.6.6 If filter-fabric is used, it should be rated for the soil texture.

Annex A – Soil Management flow chart (This annex is not part of the ANSI A300 Part 2 standard.)



Annex B – Site soil sampling guidelines (This annex is not part of the ANSI A300 Part 2 standard.)

B-1 The number of samples taken may depend on the size of the site, the variability of soils at the site, history and the level of accuracy needed.

B-2 When soil conditions appear variable, planting sites may be divided into sampling units.

B-3 The soil samples should be representative of the planting areas.

B-4 Samples taken at the 0- to 6-inch (0- to 15-cm) layer are typically done to assess chemical properties of the soil.

B-5 Samples taken at deeper measurements are typically done to identify changes in profile (textural changes), obstructions to drainage, and propensity for root development.

B-6 Sampling guidelines specific to pH tests

B-6.1 When a plant is present or planned, the depth of sampling should be equivalent to the depth of the plant's absorbing root system.

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