

Tree Planting Area Size: Futuring Resource Availability and Identifying Constraints

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The success of tree plantings in communities and yards is dependent upon many features of species, site and planting procedure. One component of site which directly affects new tree success, continued low maintenance growth, and relatively long life-span is the open soil surface area and volume of soil colonized by roots. Selecting new planting sites for the availability of adequate resources, now and into the future, as trees expand their resource control areas and grow is critical. Providing enough space and associated resources will maximize the chances of producing a great, long-lived tree.

The amount of soil area needed for sustaining a tree is dependent upon tree resource demands. One way of gauging resource requirements in trees is estimating the stem diameter and rate of growth. Defined below is a calculation procedure to help determine the amount of space needed for a tree of a given size and growth rate.

Individual pieces of information needed to estimate minimum planting space size are:

- A) Current tree diameter in inches.
- B) Estimated number of annual growth increments in the last inch of growth.
- C) Expected tree life span and/or planning event horizon in years.
- D) Short axis distance of potential planting spot in feet (if space is limited).
- E) Clear management objectives for the tree planting program and specific sites.

To calculate the size and dimensions of a minimum tree planting area, use the following steps:

Step #1: Determine the tree growth rate percentage (per year) from examining or estimating the number of annual growth increments (annual rings) within the outer, last inch of wood/xylem growth. (See Table 1)



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Step #2: Determine the future tree diameter (in inches) at 4.5 feet above the ground based upon the current tree diameter (in inches) and the annual tree growth rate percent (from Step #1).

$$\text{DIAMETER}_{\text{present}} \times ((1 + \text{GROWTHRATE}\%)^{\text{(event horizon in years)}}) = \text{DIAMETER}_{\text{future}}$$

-- Select an event horizon in years that represents an average growth rate percentage across less than ten (10) years in time. For long periods of time, recalculate an average growth rate percentage at least every 10 years. Currently small diameter trees will require shorter calculation intervals (5 years), while longer time frames can be used for each calculation in large trees (15 years).

Step #3: Determine the minimum rooting area of a tree (at some future diameter) in square feet.

$$\text{DIAMETER}_{\text{future}} \times 15.7 = \text{minimum Rooting Area (RA) in square feet}$$

STOP HERE, if potential planting space (short and long axis dimensions) is not limited.

-- Determine the side dimension of a square planting space in feet by taking the square root of RA.

-- Determine the diameter of a circular planting space in feet by multiplying DIAMETER_{future} (inches) by 2.5.

Step #4: Determine the shortest axis (width in feet) that would be biologically available for tree root colonization in the potential planting area. (See Figure 1).

-- If the short axis (width in feet) is less than the structural root limit for a future expected diameter then do not plant a tree on that site. (See Table 2)

Step #5: If planting space is limited, determine the long axis (length in feet) in the potential planting area.

$$\text{R A} / \text{SHORTaxis} = \text{LONGaxis}$$

TABLE 1: PERCENT (IN DECIMAL FORM) INCREASE IN CROSS-SECTIONAL AREA OF A TREE PER SINGLE GROWTH INCREMENT. TABLE RANGES ACROSS DIAMETERS (INCHES DBH) FROM 1 .0 GROWTH INCREMENT PER INCH (R1 .0) TO 20 GROWTH INCREMENTS PER INCH (R20.0).

DIAM	R1.0	R1.5	R2.0	R2.5	R3.0	R4.0	R5.0	R7.5	R10.0	R12.5	R15.0	R17.5	R20.0
6	1.25	0.65	0.44	0.33	0.27	0.19	0.15	0.10	0.07	0.06	0.05	0.04	0.03
7	0.96	0.53	0.36	0.28	0.22	0.16	0.13	0.08	0.06	0.05	0.04	0.03	0.03
8	0.78	0.44	0.31	0.24	0.19	0.14	0.11	0.07	0.05	0.04	0.03	0.03	0.03
9	0.65	0.38	0.27	0.21	0.17	0.12	0.10	0.06	0.05	0.04	0.03	0.03	0.03
10	0.56	0.33	0.24	0.18	0.15	0.11	0.09	0.06	0.04	0.03	0.03	0.02	0.02
11	0.49	0.30	0.21	0.16	0.13	0.10	0.08	0.05	0.04	0.03	0.02	0.02	0.02
12	0.44	0.27	0.19	0.15	0.12	0.09	0.07	0.05	0.03	0.03	0.02	0.02	0.02
13	0.40	0.24	0.17	0.14	0.11	0.08	0.07	0.04	0.03	0.03	0.02	0.02	0.02
14	0.36	0.22	0.16	0.12	0.10	0.08	0.06	0.04	0.03	0.02	0.02	0.02	0.01
15	0.33	0.20	0.15	0.12	0.10	0.07	0.06	0.04	0.03	0.02	0.02	0.02	0.01
16	0.31	0.19	0.14	0.11	0.09	0.07	0.05	0.03	0.03	0.02	0.02	0.01	0.01
17	0.29	0.18	0.13	0.10	0.08	0.06	0.05	0.03	0.02	0.02	0.02	0.01	0.01
18	0.27	0.17	0.12	0.10	0.08	0.06	0.05	0.03	0.02	0.02	0.02	0.01	0.01
19	0.25	0.16	0.11	0.09	0.07	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01
20	0.24	0.15	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01
25	0.18	0.12	0.09	0.07	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.01
30	0.15	0.10	0.07	0.06	0.05	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.007
35	0.13	0.08	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.007	0.007
40	0.11	0.07	0.05	0.04	0.03	0.03	0.02	0.01	0.01	0.01	0.007	0.007	0.005
45	0.10	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.01	0.007	0.007	0.005	0.005
50	0.09	0.06	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.005
55	0.08	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.007	0.007	0.005	0.005	0.005
60	0.07	0.05	0.03	0.03	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.005	0.005
65	0.07	0.04	0.03	0.03	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.005	0.003
70	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.007	0.005	0.005	0.003	0.003
75	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.005	0.003	0.003
80	0.05	0.03	0.03	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.003	0.003	0.003
85	0.05	0.03	0.02	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.003	0.003	0.002
90	0.05	0.03	0.02	0.02	0.02	0.01	0.01	0.007	0.005	0.005	0.003	0.003	0.002
95	0.04	0.03	0.02	0.02	0.01	0.01	0.01	0.007	0.005	0.003	0.003	0.002	0.002

FIGURE 1: DIAGRAMMATIC VIEW OF POTENTIAL TREE PLANTING AREAS WITH LONG AXIS (LENGTH IN FEET) AND SHORT AXIS (WIDTH IN FEET) IDENTIFIED. THE SHORT AXIS COULD BE CONSTRAINED BY SIDEWALKS, LIMITS ON TREE LAWNS, HARDSCAPE CONTAINERS, OR OTHER OPEN SOIL SURFACE CONSTRAINTS.

potential tree planting area

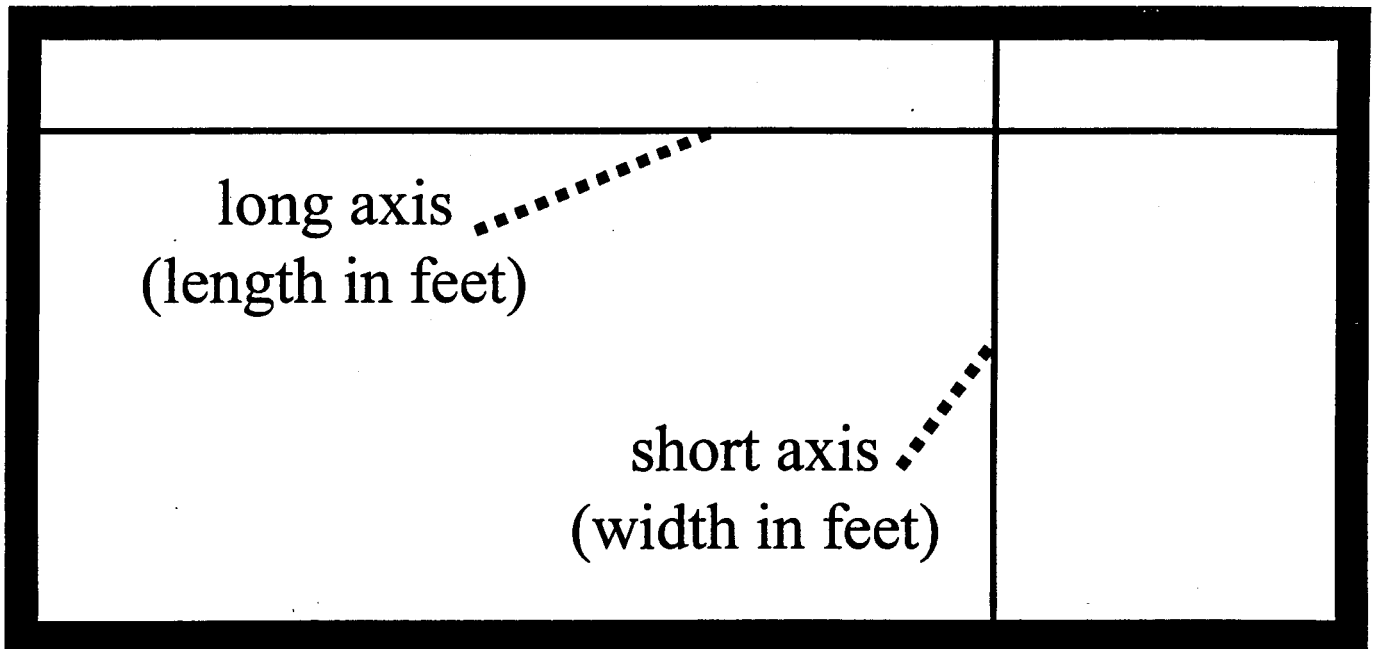


TABLE 2: STRUCTURAL ROOT LIMIT OR THE MINIMUM ALLOWABLE AXIS WIDTH ACROSS A TREE'S ROOTING AREA (BY DIAMETER CLASS) NEEDED TO MAINTAIN THE STRUCTURAL INTEGRITY OF THE ROOT PLATE AREA .

FUTURE. TREE DIAMETER (inches dbh)	MINIMUM SHORT AXIS STRUCTURAL ROOT LIMIT (feet of diameter)	FUTURE TREE DIAMETER (inches dbh)	MINIMUM SHORT AXIS STRUCTURAL ROOT LIMIT (feet of diameter)
1	2	26	20
2	4	27	20
3	4	28	20
4	6	29	20
5	6	30	20
6	8	31	20
7	8	32	20
8	10	33	20
9	10	34	20
10	12	35	20
11	12	36	20
12	14	37	22
13	14	38	22
14	14	39	22
15	16	40	22
16	16	45	22
17	16	50	24
18	16	55	24
19	18	60	26
20	18	65	26
21	18	70	28
22	18	75	28
23	18	80	30
24	20	85	30
25	20	90	32
		95	32
		100	32