

I-Eco Project over nine cities in Idaho's Treasure Valley

Lessons learned, suggested changes, tools and tricks

General Overview

This report covers lessons learned throughout the project, and suggestions that would help the project move smoother with future teams. Also discussed are tools developed to make the project easier to execute and save time. Suggestions are included to increase effectiveness and ease of use for the iTree Eco program, including problems we identified that made the process a little slower. Finally, we describe the ideal process to go about gathering the data on the plot.

ITree-Eco Process Improvements/Suggestions

After using the iTree program for 250 plots collectively, we observed a variety of issues and have the following suggestions for improvements:

- Perhaps the most important decision in an i-Tree project is whether or not to pre-stratify. A discussion of the pros and cons of pre- versus post-stratification either in the manual or as a separate document would be helpful.
- Occasionally, the centers of some plots were inaccessible, and there were better TMPs located outside the plot boundary. However, the iTree program does not allow a TMP to be more than 37.2 feet away from any tree. That is, TMPs had to be within the plot boundary. We suggest a modification to the program that would allow a TMP to be located outside of the plot boundary.
- When the crown base for a tree or shrub was at ground level, we were unable to enter a value of 0. Instead, the program required a minimum distance of 1 foot. This may not be a significant issue.
- Discrepancy with Tree height to building measurement
 - The manual states that a tree that is 20' tall is to be measured to a residential building within 60 feet. The ITree Eco PDA program indicates the tree only has to be 16.7 feet tall. The PDA and manual should be consistent.
- At the beginning of the project, we did have a serious issue with data loss on the PDAs and were unable to determine the cause. However, we did implement several protocols to prevent future data loss. Ensuring all data is collected and marking the plot complete at the plot site was important. The team member not using the PDA took hard copy notes on data that can only be gathered at the plot location. These precautions helped minimize data loss.
- Overall the PDA program worked well. It is designed in a way that makes the user collect the data of one item before moving on to the next. This may be annoying to some operators who may be collecting data in a different order. However it ensures all the data is collected.
- Output: A report table that identifies air quality data by species is very desirable. It is important for areas where air quality is an issue to understand which species are most problematic with respect to biogenic VOC production and their contribution to ozone.

- Other Issues:

- The most challenging aspect of an i-Eco project is getting permission to enter private property. Often, homeowners were not at home during the day when our survey teams were out. We used direct mailings, door hangers, phone calls when numbers could be determined, etc. explaining the project and asking for permission. Many people only have cell phones, making finding phone numbers nearly impossible. For the 250 plots, 17 were unable to be completed due to the inability to gain permission to enter private property.

Plots that were on public lands, commercial property or in areas where plot information could be gathered from the photographs alone (agriculture lands, water, etc.) were much easier to complete, setting up a bias against plots in residential areas, especially where a plot fell on multiple properties. Note that we did not pre-stratify plots.

We had additional plots identified to replace those that were “inaccessible” due to an inability to garner permission. However, the same issues arose with these when trying to complete them in order so as not to bias the random distribution of plots. Some were easy to complete, while others more difficult—again due to the inability to contact or get a response from the property owner for permission.

This is likely a very common occurrence for any project, and discussion of how best to deal with this from a statistical perspective within the manual would be very helpful. Researchers should be aware of the real world issues with respect to completing plots. Inaccessibility is more an issue of a lack of permissions to enter private property than physical terrain, and can insert unwanted bias.

I’d also recommend hiring a person three to four weeks in advance of the survey teams whose sole work is gaining permissions—this takes a great deal of time.

- Quality Assurance checks:

It’s important when requesting permission to let folks know that another team might come back later to do the plot over and why, and to ensure that’s OK. There are additional challenges with respect to this, and this may influence which plots are available to be QA’d by the other team.

Tools/Tricks

Tools and methods to save time and increase accuracy

- In some plots, the center was on a hard surface, preventing use of a stake or chaining pin as the pivot point for laying out the plot circumference. In these situations, we placed a traffic cone in the plot center, fed the fixed radius cable through the hole on top of the cone and hooked it to a survey pin on the inside. The cone served as a pivot point for measuring the plot boundary. Note: This only works if the cone is new and the top isn't broken or cracked.
- Calculating land cover areas with plot photographs and a dot grid
 - We prepared plot photographs in ArcMap with 1/10 acre plot boundaries (buffered from randomly selected points). Base imagery was high resolution (4" and 12") digital aerial photography. Scale was 1:200. These were exported as JPG images.
 - The scale at which different printers print is inconsistent. The printer used to print the plot photographs was calibrated (image shrunk or enlarged) such that actual scale was 1" equals 20 feet. This allowed use of an engineering ruler (graduated in tenths of an inch to help calculate distances).
 - Regardless of printed scale, use of an English Area dot grid is invaluable in calculating % plot areas. Simply lay the dot grid over the photo and count the number of dots within the plot circle. Enter this number at the top of the attached spreadsheet. This creates a table that correlates the number of dots to a plot percentage, making it easy to calculate land cover areas with the aerial plot photographs. See attached sample.
- Calculating tree canopy as a percentage of plot
 - We printed out on transparent print stock a series of circles of different sizes on one sheet. Using the dot grid, dots were counted within each circle to calculate the % area of the plot comprised by the circle. These were printed onto the circles. By overlaying the circle that roughly fit a given tree on the plot photos, the area was quickly determined.
- Calculating shrub area
 - While shrub area can be calculated with the same circle templates used for trees, they are often too small to pick up accurately on an aerial photo. The following method was developed to calculate shrub area:
 - We created a shrub area conversion table (see attached). Measure the diameter of the shrub and find it in the first column. The corresponding area in square feet is in the next column. $[(d/2)^2 * 3.14]$
 - Add up the square feet of all shrubs to find the total area and divide this by 4345 (square feet in a 1/10 acre plot) to get total percent area of shrubs in a plot.
- Hypsometer use
 - Not only was the hypsometer used to measure tree height, but it was very accurate at measuring distances as well, especially when distances exceeded 100'. Use of a reflector was necessary—or even using the reflective stripes on the safety vests—when targeted objects were dark in color.

Eco Project Equipment

| iTreetools.org Suggested Tools | What we used |
|---|---|
| <ul style="list-style-type: none"> • Clinometer – for measuring tree & bole height | <ul style="list-style-type: none"> • TruePulse 200 Laser Rangefinder/hypsometer— Excellent tool! We used a piece of reflective tape as target (used a piece of an old Tree City decal and affixed it to a thin piece of wood) for distances. |
| <ul style="list-style-type: none"> • Laser range finder or hypsometer- optional for measuring heights & distances | |
| <ul style="list-style-type: none"> • GPS Unit – Optional for locating plot centers in forested areas | <ul style="list-style-type: none"> • Garmin Oregon 550t GPS w/3.2 MP camera – great for geo-referencing photos. Note that the compass on this Garmin was affected by the metal carabiner clip and needed to be recalibrated frequently— something to be cautious about. • Purchased 4 GB memory for these |
| <ul style="list-style-type: none"> • Camera – optional for taking pictures of plot for future reference | |
| <ul style="list-style-type: none"> • Compass – locating reference objects, trees within plots | <ul style="list-style-type: none"> • Lufkin Pro Series 100' Cloth Tape |
| <ul style="list-style-type: none"> • Measuring tape - 50m or greater for multiple measurements | |
| <ul style="list-style-type: none"> • Diameter tape – Tree DBH | <ul style="list-style-type: none"> • Lufkin Yellow-clad Loggers tape (10th's) (suggested a vinyl tape instead of metal, which kinks easily) |
| <ul style="list-style-type: none"> • PDA – running Windows Mobile 5.0 or greater for integrated data collection using software | <ul style="list-style-type: none"> • HP PDA's w/memory cards (don't need much memory). |
| <ul style="list-style-type: none"> • PDA storage card & PDA protection - optional | |
| <ul style="list-style-type: none"> • Safety Vests | <ul style="list-style-type: none"> • Surveyors safety vest—while important, these were very hot. Consider neon t-shirts with <i>i-Tree Survey Team</i> printed on them. |
| <ul style="list-style-type: none"> • Pin flags/Chaining pin – used for marking plot center & boundaries | <ul style="list-style-type: none"> • Survey pins (set of 11) • Survey pin quiver |
| <ul style="list-style-type: none"> • Area maps – used for locating plots within study area | <ul style="list-style-type: none"> • Atlas of area—also posted plots on Garmin Basecamp software and Google Earth |
| <ul style="list-style-type: none"> • High resolution photo of individual plots – assist with locating plot center and plot elements | <ul style="list-style-type: none"> • 4" to 12" resolution prior year aerial digital photography—used with ArcMap to develop plot photos. Printed and calibrated with printer such that 1" equals 20'. This allowed use of a standardized dot grid for measuring area and an engineers rule graduated in tenths of an inch to help with distance calculations. |
| <ul style="list-style-type: none"> • Binoculars – optional for viewing canopy | <ul style="list-style-type: none"> • 12x25 binoculars, found we didn't need/use these |
| <ul style="list-style-type: none"> • Flagging tape – used to mark trees that have been measured in plots with many trees | <ul style="list-style-type: none"> • Flagging tape |
| <ul style="list-style-type: none"> • Clipboard, data sheets, pens/pencils for data recording | <ul style="list-style-type: none"> • Cruiser Kit/Map Case • Workmate portable desk |
| <ul style="list-style-type: none"> • Plastic bags – used for collecting unknown plant samples for further identification | <ul style="list-style-type: none"> • Zip-lock bags |
| <ul style="list-style-type: none"> • Chalk – used for marking measured trees or marking plot boundaries on pavement | <ul style="list-style-type: none"> • Sidewalk chalk in neon colors |
| <ul style="list-style-type: none"> • Species ID guide – optional to assist with identification | <ul style="list-style-type: none"> • Horticulture Students (2) interns from local college were part of each team. They had a wealth of plant ID resources with them. |

| Additional equipment we found very useful | |
|---|---|
| <ul style="list-style-type: none"> • 25' tape measure graduated in tenths of a foot—easier to use for shorter measurements | <ul style="list-style-type: none"> • Irrigation flags—easier to use for identifying plot circumference |
| <ul style="list-style-type: none"> • English Area Dot Grid – invaluable to calculate plot percentages of different land cover | <ul style="list-style-type: none"> • Circle area conversion key—different sized circles printed on clear sheets and calibrated to photo scale allowed easy calculations for converting shrub and tree circumference to plot percentages |
| <ul style="list-style-type: none"> • Dot Grid conversion table calibrated to photo scale—used with Dot Grid made area calculations fast and easy | <ul style="list-style-type: none"> • 6" engineers ruler (tenths)—to assist with photo measurements |
| <ul style="list-style-type: none"> • EneLoop rechargeable batteries & Battery charger for GPS and Hypsometer | <ul style="list-style-type: none"> • Protractor |
| <ul style="list-style-type: none"> • 37.2' fixed radius plot cable – for quick, accurate marking of plot circumference—expensive, but worth it | <ul style="list-style-type: none"> • State ID Badges to readily identify survey crews |
| <ul style="list-style-type: none"> • Safety traffic cones (3) – these were important when near roads and very useful when plot center was on hard surfaces—see tips below | <ul style="list-style-type: none"> • Tote Bag – for all the gear |
| <ul style="list-style-type: none"> • Laminating sheets for assorted documents | <ul style="list-style-type: none"> • 2-hole punch |
| <ul style="list-style-type: none"> • Small Portable Calculator | <ul style="list-style-type: none"> • Permanent Markers |
| <ul style="list-style-type: none"> • Google Earth—all plots converted to KLM files | <ul style="list-style-type: none"> • Garmin Basecamp—all plots converted to GPX—helped find plots and best routes to get to them |
| <ul style="list-style-type: none"> • First aid kit for each team | <ul style="list-style-type: none"> • |

Suggested Method for Recording Plot Data

Note that for this narrative, team members are identified as team member 1 (TM1) and team member 2 (TM2).

- Arrive at Plot.
- Find the plot center using the scale photo and a ruler to find the distance and a protractor to find the heading from the object to the center of the plot. The object needs to be something that is clearly visible in the aerial photo and is still present in the plot when you visit (e.g. end of a fence, corner of a tennis court, or a building corner)
- TM2 measures the location of the plot center from the object determined in the previous step while TM1 finds the correct heading.
- Once the plot center has been located, TM2 marks it with two surveying pins or, if center plot is located on an impervious surface, places a traffic cone in the center. If the plot center is inaccessible follow the manual's instructions for identifying and establishing a TMP.
- With the plot center located, the distance and heading to at least two permanent objects used as reference points is recorded. The object used to find the plot center can be used as long as it meets the requirements for a reference point as determined in the manual.

- With the reference objects recorded attach the 37.2' cable to the two surveying pins in the center. TM2 runs the cable out its full length while TM1 stands in the center of the plot and give headings. Cardinal directions are marked with surveying pins. Irrigation flags are placed at intervals along the plot boundary between pins to visually identify the plot boundary. These are also useful for reference in the plot photos.
- Once the plot is sufficiently marked, TM1 takes pictures of the plot. In the left column is the order in which they are taken; the right column is the corresponding name.

| From the center facing North | 3_view_N |
|----------------------------------|---------------|
| From the center facing East | 3_view_E |
| From the center facing South | 3_view_S |
| From the center facing West | 3_view_W |
| From North facing center of plot | 3_2view_N |
| From East facing center of plot | 3_2view_E |
| From South facing center of plot | 3_2view_S |
| From West facing center of plot | 3_2view_W |
| Reference point 1 | 3_reference_1 |
| Reference point 2 | 3_reference_2 |
| Tree 1... | 3_tree__1 |



- If for some reason a photo cannot be taken, make a note in order to make the naming of the files easier later. If unable to take photos looking toward the plot center, take pictures of the individual trees in the order they appear starting at the north point and working clockwise until returning to north.
- While TM1 is taking photos, TM2 can enter land use and ground cover into the PDA.

The following two steps can be interchanged.

Tree data collection

- TM1 stands in the center of the plot and gives the address to TM2, who enters the heading and distance to the tree from the center of the plot. In no particular order the team collects the following data together.
 - Species
 - Tree Height (using digital hypsometer)

- Status of Tree
 - Live Top
 - North-South width of Crown (using tape or hypsometer/rangefinder)
 - East-West width of Crown (using tape or hypsometer/rangefinder)
 - Height of Crown Base (using digital hypsometer)
 - Crown Light Exposure
 - Percent of canopy over impervious surface
 - Percent of shrubs under the canopy
 - Percent of the canopy missing
 - Percent of the canopy that has dieback
- After this data above has been collected, the team records the tree diameter (DBH). (See I-tree manual for DBH data collection guidelines.)
 - Finally, if the tree is 20 feet or taller and there is a residential building within 60 feet, record the distance and heading to the nearest part of the building(s). (See I-tree manual for further rules on this step)

Shrub Data Collection

- TM2 measures height & diameter while TM1 records species and the measurements on a notepad. Lump the same height of the same species together in one category. If the heights are significantly different, create a second entry for the same species. Once shrub measurements have been recorded, both team members use the shrub cheat sheet to give each of the different species a percent of the shrub cover as well as finding the total shrub cover. After percent calculations are complete, TM2 enters the data into the PDA.
- After all the data is collected, make sure the plot is marked complete in the PDA before leaving the plot. This lowers the chance of data being lost.

Taking Notes

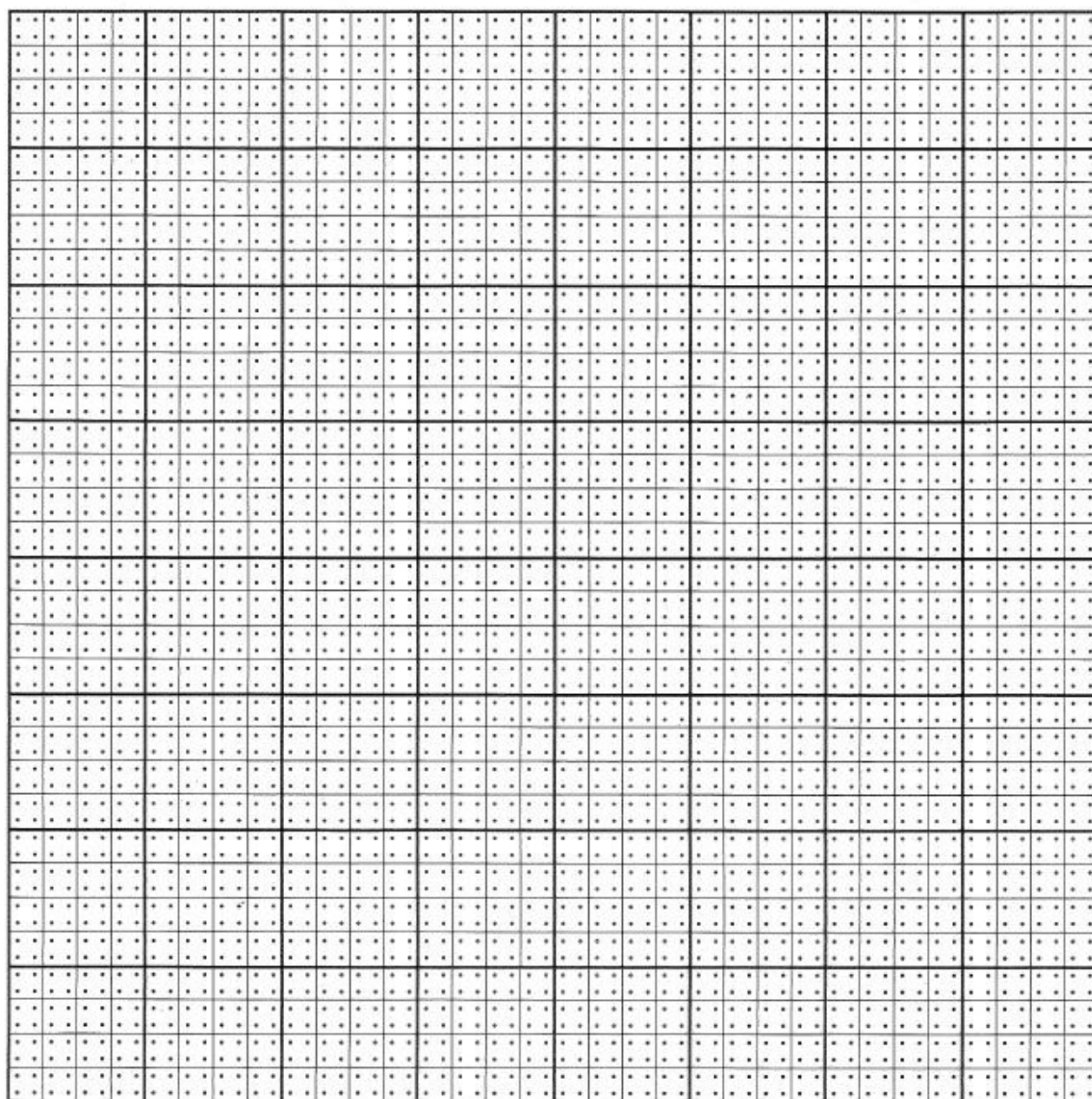
During the shrub & tree data collection while the TM2 is entering the information into the PDA, TM1 can be taking notes in case of accidental data loss. Notes do not need to be extremely detailed as this will slow down the team, but sufficient to recreate measurements that can only be determined at the plot site.

Sample Plot Photo—4" resolution (not to scale)



Tools to help calculate land cover areas as a percentage of plot area

Graphic of dot grid used (not to scale)



ENGLISH AREA GRID SUPER SIZE: Stock No. 45009



Forestry Suppliers, Inc.

www.forestry-suppliers.com

P. O. Box 8397 • Jackson, MS 39284

800-647-5368

| SCALE OR RATIO | | | AREA PER SQUARE INCH | CONVERSION FACTOR: EACH DOT EQUALS |
|-------------------|--------------------|---------|--|---|
| 1 inch: 1 inch | — | — | 1 square inch | 0.0156 square inches |
| 1 inch: 1 inch | — | — | 1 square foot 144 square inches | 0.0156 square feet 2.25 square inches |
| 1 inch: 1 yard | — | — | 1 square yard 9 square feet 1296 square inches | 0.0156 square yards 0.1406 square feet 20.250 square inches |
| 1 inch: 500 feet | 10.56 inches: mile | 1:6000 | 5.740 acres | 0.0897 acre |
| 1 inch: 1000 feet | 5.28 inches: mile | 1:12000 | 22.957 acres | 0.359 acre |
| 1 inch: 1320 feet | 4.0 inches: mile | 1:15840 | 40.00 acres | 0.625 acre |
| 1 inch: 1667 feet | 3.167 inches: mile | 1:20000 | 63.794 acres | 0.997 acre |
| 1 inch: 2000 feet | 2.64 inches: mile | 1:24000 | 91.827 acres | 1.435 acre |
| 1 inch: 3334 feet | 1.58 inches: mile | 1:40008 | 255.178 acres | 3.987 acre |
| 1 inch: 5280 feet | 1 inch: 1 mile | 1:63360 | 640 acres | 10.00 acres |

For use in determining the area of any flat surface in English measurement units. Randomly place grid over area to be computed. Count the dots that occur within the area. Multiply by the proper conversion factor to determine the total area. Count only every other dot that occurs on a boundary line of the area.

DOT GRID Statistics for 1/10 Acre Plots printed at 1" = 20'

664

dots/plot

166 small squares/plot



Enter # of dots in plot circle here to calibrate

| Dots | Area | Dots | Area | Small Sqrs | Area | Small Sqrs | Area |
|-----------|------|------------|------|------------|------|------------|------|
| 7 = 1% | | 339 = 51% | | 2 = 1% | | 85 = 51% | |
| 13 = 2% | | 345 = 52% | | 3 = 2% | | 86 = 52% | |
| 20 = 3% | | 352 = 53% | | 5 = 3% | | 88 = 53% | |
| 27 = 4% | | 359 = 54% | | 7 = 4% | | 90 = 54% | |
| 33 = 5% | | 365 = 55% | | 8 = 5% | | 91 = 55% | |
| 40 = 6% | | 372 = 56% | | 10 = 6% | | 93 = 56% | |
| 46 = 7% | | 378 = 57% | | 12 = 7% | | 95 = 57% | |
| 53 = 8% | | 385 = 58% | | 13 = 8% | | 96 = 58% | |
| 60 = 9% | | 392 = 59% | | 15 = 9% | | 98 = 59% | |
| 66 = 10% | | 398 = 60% | | 17 = 10% | | 100 = 60% | |
| 73 = 11% | | 405 = 61% | | 18 = 11% | | 101 = 61% | |
| 80 = 12% | | 412 = 62% | | 20 = 12% | | 103 = 62% | |
| 86 = 13% | | 418 = 63% | | 22 = 13% | | 105 = 63% | |
| 93 = 14% | | 425 = 64% | | 23 = 14% | | 106 = 64% | |
| 100 = 15% | | 432 = 65% | | 25 = 15% | | 108 = 65% | |
| 106 = 16% | | 438 = 66% | | 27 = 16% | | 110 = 66% | |
| 113 = 17% | | 445 = 67% | | 28 = 17% | | 111 = 67% | |
| 120 = 18% | | 452 = 68% | | 30 = 18% | | 113 = 68% | |
| 126 = 19% | | 458 = 69% | | 32 = 19% | | 115 = 69% | |
| 133 = 20% | | 465 = 70% | | 33 = 20% | | 116 = 70% | |
| 139 = 21% | | 471 = 71% | | 35 = 21% | | 118 = 71% | |
| 146 = 22% | | 478 = 72% | | 37 = 22% | | 120 = 72% | |
| 153 = 23% | | 485 = 73% | | 38 = 23% | | 121 = 73% | |
| 159 = 24% | | 491 = 74% | | 40 = 24% | | 123 = 74% | |
| 166 = 25% | | 498 = 75% | | 42 = 25% | | 125 = 75% | |
| 173 = 26% | | 505 = 76% | | 43 = 26% | | 126 = 76% | |
| 179 = 27% | | 511 = 77% | | 45 = 27% | | 128 = 77% | |
| 186 = 28% | | 518 = 78% | | 46 = 28% | | 129 = 78% | |
| 193 = 29% | | 525 = 79% | | 48 = 29% | | 131 = 79% | |
| 199 = 30% | | 531 = 80% | | 50 = 30% | | 133 = 80% | |
| 206 = 31% | | 538 = 81% | | 51 = 31% | | 134 = 81% | |
| 212 = 32% | | 544 = 82% | | 53 = 32% | | 136 = 82% | |
| 219 = 33% | | 551 = 83% | | 55 = 33% | | 138 = 83% | |
| 226 = 34% | | 558 = 84% | | 56 = 34% | | 139 = 84% | |
| 232 = 35% | | 564 = 85% | | 58 = 35% | | 141 = 85% | |
| 239 = 36% | | 571 = 86% | | 60 = 36% | | 143 = 86% | |
| 246 = 37% | | 578 = 87% | | 61 = 37% | | 144 = 87% | |
| 252 = 38% | | 584 = 88% | | 63 = 38% | | 146 = 88% | |
| 259 = 39% | | 591 = 89% | | 65 = 39% | | 148 = 89% | |
| 266 = 40% | | 598 = 90% | | 66 = 40% | | 149 = 90% | |
| 272 = 41% | | 604 = 91% | | 68 = 41% | | 151 = 91% | |
| 279 = 42% | | 611 = 92% | | 70 = 42% | | 153 = 92% | |
| 286 = 43% | | 618 = 93% | | 71 = 43% | | 154 = 93% | |
| 292 = 44% | | 624 = 94% | | 73 = 44% | | 156 = 94% | |
| 299 = 45% | | 631 = 95% | | 75 = 45% | | 158 = 95% | |
| 305 = 46% | | 637 = 96% | | 76 = 46% | | 159 = 96% | |
| 312 = 47% | | 644 = 97% | | 78 = 47% | | 161 = 97% | |
| 319 = 48% | | 651 = 98% | | 80 = 48% | | 163 = 98% | |
| 325 = 49% | | 657 = 99% | | 81 = 49% | | 164 = 99% | |
| 332 = 50% | | 664 = 100% | | 83 = 50% | | 166 = 100% | |

Shrub Area for Given Diameters

| Diameter | Square Feet |
|----------|-------------|
| 0.5 | 0.20 |
| 1 | 0.79 |
| 1.5 | 1.77 |
| 2 | 3.14 |
| 2.5 | 4.91 |
| 3 | 7.07 |
| 3.5 | 9.62 |
| 4 | 12.56 |
| 4.5 | 15.90 |
| 5 | 19.63 |
| 5.5 | 23.75 |
| 6 | 28.26 |
| 6.5 | 33.17 |
| 7 | 38.47 |
| 7.5 | 44.16 |
| 8 | 50.24 |
| 8.5 | 56.72 |
| 9 | 63.59 |
| 9.5 | 70.85 |
| 10 | 78.50 |

| Diameter | Square Feet |
|----------|-------------|
| 10.5 | 86.55 |
| 11 | 94.99 |
| 11.5 | 103.82 |
| 12 | 113.04 |
| 12.5 | 122.66 |
| 13 | 132.67 |
| 13.5 | 143.07 |
| 14 | 153.86 |
| 14.5 | 165.05 |
| 15 | 176.63 |
| 15.5 | 188.60 |
| 16 | 200.96 |
| 16.5 | 213.72 |
| 17 | 226.87 |
| 17.5 | 240.41 |
| 18 | 254.34 |
| 18.5 | 268.67 |
| 19 | 283.39 |
| 19.5 | 298.50 |
| 20 | 314.00 |

Add all shrub areas together and divide by 4345 to get total shrub percent of plot.

Divide each shrubs area by total shrub area to determine an individual shrubs percentage of the total shrub area.

Circle template – (not to scale)

>1%

>1%

~1%

~1%

3%

5%

7%

20%

15%

11%

31%

25%

36%

44%