

NET FACTOR PROCEDURES FOR LOSS INDICATORS

| | | | | | | | |
|-----------------------|--|--|-----------------|-----|---|----------|------------|
| Rot Possibly Visible | Blind Conk | 4m above top Conk | | | | Y grade | N.F. = 50% |
| | | 6m below bottom Conk | | | | | |
| | Conk (Heart Rot) | 4m above top Conk | | | | Y grade | N.F. = 50% |
| | | 6m below bottom Conk | | | | | |
| | Frost Crack* | Deduction length=Total frost crack lengths x 10% *Max N.F. Ded = 40% | | | | | Then (A) |
| | Root Rot (DRS) (rot NOT visible) | 3 m log (if DRS conk on stem, then log extends 3 m above highest DRS conk) | | | | X grade | N.F. = 81% |
| Rot MUST be Visible | Broken Top | Deduction length = 1.0m always; or 1.0m below 'Y' grade N.F. = 0% | | | | | Then (A) |
| | Butt Rot (Sounding)/ Catface (Conical) | (1) | Diameter of rot | (2) | See Butt Rot Table | (3) | Then (A) |
| | | | [DBH] | | | | |
| | Catface (Cylinder) | Deduction length = [Diameter of rot/Log diameter]2 x Rot Length | | | Then divide by 2 if starting with \triangle vs \square ; Then (Butt Rot Guide) | | Then (A) |
| | Dead Top/ Sap Rot | N.F. % = [Diameter of Core/Diameter of Log]² x 100% | | | | | |
| | Fork / Crook | 1.0m below 'Y' grade N.F. = 50%; or Deduction Length = 0.5m | | | | | Then (A) |
| | Large Rotten Branch (Knots >10cm) | 1.0m above and below 'Y' grade N.F. = 50%; or Deduction Length = 1.0m | | | | | Then (A) |
| | Root Rot (rot VISIBLE) | N.F.% = 100% - [19%*[Decay length/Log Length]] | | | | | |
| | Scar (Measurable)/ Missing Wood | N.F.% = [Volume of Log - Volume of Decay/Volume of Log] x 100%; or Rot Diameter= [$\sqrt{(\text{depth}*\text{width}/\pi)}$]*2; Then (Butt Rot Guide) | | | | | |
| Scar (Non-Measurable) | Deduction length = [Scar width/(6.3* diameter log)]* scar length | | | | | Then (A) | |

| Prism Plot Radius Factors | | |
|---------------------------|------------------|------------------|
| BAF | PRF _c | PRF _f |
| 5 | 0.2236 | 0.2186 |
| 7 | 0.1890 | 0.1840 |
| 9 | 0.1667 | 0.1617 |
| 12 | 0.1443 | 0.1393 |
| 16 | 0.1250 | 0.1200 |
| 20 | 0.1118 | 0.1068 |
| 25 | 0.1000 | 0.0950 |

BAF selection must be made prior to arriving at the reference pin

The same BAF must be used for all plots in the cluster

The final "IN" or "OUT" determination for all borderline trees will be made from the face of the tree, not the center

Table 5.1 - Formulas for calculating volume

| Shape | Formula |
|--|------------------------------|
| Rectangular solid | Voume = L*W*D |
| Cylinder | Volume = $\pi r^2 * L$ |
| Cone | Volume = $(1/3) \pi r^2 * L$ |
| Units must be consistent (all cm or all m). π = 3.1416 | |

| Relaskop Plot Radius Factors | | | |
|------------------------------|-------|------------------|------------------|
| BANDS | BAF | PRF _c | PRF _f |
| 2.25 | 5.06 | 0.2222 | 0.2172 |
| 2.50 | 6.25 | 0.2000 | 0.1950 |
| 3.00 | 9.00 | 0.1667 | 0.1617 |
| 3.50 | 12.25 | 0.1429 | 0.1379 |
| 4.00 | 16.00 | 0.1250 | 0.1200 |
| 4.50 | 20.25 | 0.1111 | 0.1061 |
| 5.00 | 25.00 | 0.1000 | 0.0950 |

| BUTT ROT GUIDE FOR LENGTH DEDUCTIONS | | |
|--------------------------------------|------------|------------------|
| RATIO = length of rot/DBH | LENGTH | Deduction Length |
| 1/4 DIAMETER | 1.8 - 2.4m | 0.2m |
| 2/4 DIAMETER | 3.6 - 4.2m | 0.4m |
| 3/4 DIAMETER | 5.4 - 6.0m | 1.2m |
| 4/4 DIAMETER | 7.2m | 2.4m |

Net Factor Notes

Broken tops, dead tops, forks and crooks only net factored if there is visible decay

SNG not necessary on trees with heart rot conks, DRS

Pinicola conks generally grow on dead wood and are not heart rot conks and do not

have a 50% NF. Only treated as a heart rot conk if it is growing on live wood

To calculate the PRF_c of any BAF:

PRF_c = 0.5/ $\sqrt{\text{BAF}}$

PRF_c = Plot Radius Factor to Centre of Tree

PRF_f= Plot Radius Factor to the face of the tree

PRF_f = PRF_c - 0.005

Formula (A) N.F.% = $\frac{[\text{Log length}-\text{Deduction length}]}{[\text{Log length}]}$ x 100% Deduction Length = %Rot * Log Length

| Shape | Formula |
|--|------------------------------|
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| Cylinder | Volume = $\pi r^2 * L$ |
| Cone | Volume = $(1/3) \pi r^2 * L$ |
| Units must be consistent (all cm or all m). π = 3.1416 | |

To calculate the PRF_c of any BAF:

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PRF_f = PRF_c - 0.005

| Crown Class Codes | | | |
|-------------------|-----------------------------------|--------------------------|------------------|
| Crown Class Codes | Relationship vs Surrounding Trees | Tree and Crown Size | Crowding |
| D - Dominant | Extended above | Taller, well developed | Only somewhat |
| C - Co-dominant | Same level | Smaller than dominant | Crowded on sides |
| I - Intermediate | Below or extending into co-doms | Smaller, less developed | Quite crowded |
| S - Suppressed | Generally below co-dom crowns | Smallest, less developed | Overtopped |

| Split Plots | | |
|---|-------------------|-----------------------|
| Large tree count >10 or Small tree count > 50 | | |
| Sample # | Half | Quarter* |
| Even | East 1/2 of plot | Northwest 1/4 of plot |
| Odd | West half of plot | Southwest 1/4 of plot |
| * Quarter plots for fixed radius plots only | | |

| Age Measure Codes | |
|-------------------|--|
| CRC | Cannot reach Center - Needs Prorate Length |
| NOP | Pith Missed - Needs Missed Years |
| OUT | Out of Plot tree |
| PRE | Age from Previous Measure |
| PTH | Pith Obtained |
| ROT | Rot in Center - Needs Prorate Length |
| WHO | Whorls above Breast Height |
| NOC | Core not collected |

| CMI Sample Tree Selection | | | | | | | | |
|---------------------------|-------------------------------|---------|------|------|------|------------|-----------|--------------------------|
| | Population Selection Criteria | | | | | | | Tree Selection Criterion |
| Type | Plot | Species | B.A. | L/D | C.C. | Age Suit. | Ht. Suit. | Only 1 Consideration |
| T | 5.64 Plot | | | Live | D/C | | | Largest DBH |
| L | 11.28 Quad | Leading | | Live | D/C | Non-Resid. | | Largest DBH |
| S | 11.28 Quad | Second | >20% | Live | D/C | Non-Resid. | | Largest DBH |
| O | 11.28 Quad | Other | >20% | Live | D/C | Non-Resid. | | Largest DBH |
| V | 11.28 Plot | | | Live | | Residual | | Representative |
| X | | | | | | | | Representative |

| VRI Sample Tree Selection | | | | | | | |
|---------------------------|-------------------------------|---------|----------------|---------------|---------------|---------------|--------------------------|
| | Population Selection Criteria | | | | | | Tree Selection Criterion |
| Type | Plot | Species | L/D | C.C. | Age Suit. | Ht. Suit. | Only 1 Consideration |
| T | 5.64 Plot | | Live | D/C | | | Largest DBH |
| L | 5.64 Plot | Leading | Live | D/C | | | Largest DBH |
| S | 5.64 Plot | Second | Live | D/C | | | Largest DBH |
| O | 5.64 Plot | | Typically Live | Typically D/C | Typically "Y" | Typically "Y" | Subjective |
| X | Outside 5.64 Plot | | Typically Live | Typically D/C | Typically "Y" | Typically "Y" | Subjective |

| Mode Description | | |
|------------------|--|--|
| Code | Description | Attributes Required |
| D | Dropped - A previously measured tree that is to be dropped because it was outside of the plot. | Requires sector, species, DBH and stem map azimuth and distance |
| F | Forest Health - A tree in a Type- A (Early YSM- Forest Health) sample that is below the standard YSM tagging limits | Requires all attributes (may or may not have a DBH, depending on length) |
| H | Harvested - A previously measured tree that cannot be found and has obviously been harvested or cut | Only requires sector and species |
| M | Missed - A tree that was obviously missed at the previous measurement. | Requires all attributes |
| N | Not Found - A previously measured tree that cannot be found | Only requires sector and species |
| P | Planted, Too Small - A planted seedling identified and tagged in a Type-A (Early YSM - Planted) sample | Requires all attributes except DBH, CC and Ht to Live Crown |
| Z | Non Tally Sample Tree - A tree that is not tallied yet is a selected as a sample tree | Requires all attributes |

| Photo Descriptions | | | |
|-----------------------------------|---------------------|--|-------------------|
| Types with CWD (F, O, D, E, C) | | Types without CWD (M, Y, L, PSP, Q, Z, T, B, N) | |
| Code | Description | Code | Description |
| PP | Plot Pin | PP | Plot Pin |
| T1S | Transect 1 Start | N | North |
| T2S | Transect 2 Start | E | East |
| T1M | Transect 1 Mirrored | S | South |
| T2M | Transect 2 Mirrored | W | West |
| T1E | Transect 1 End | - | - |
| T2E | Transect 2 End | - | - |
| REP | Representative | REP | Representative |
| CAN | Canopy (Vertical) | CAN | Canopy (Vertical) |
| SOIL | Soil Profile* | SOIL | Soil Profile* |
| OTH | Other** | OTH | Other** |

*Required only if a soil pit is dug

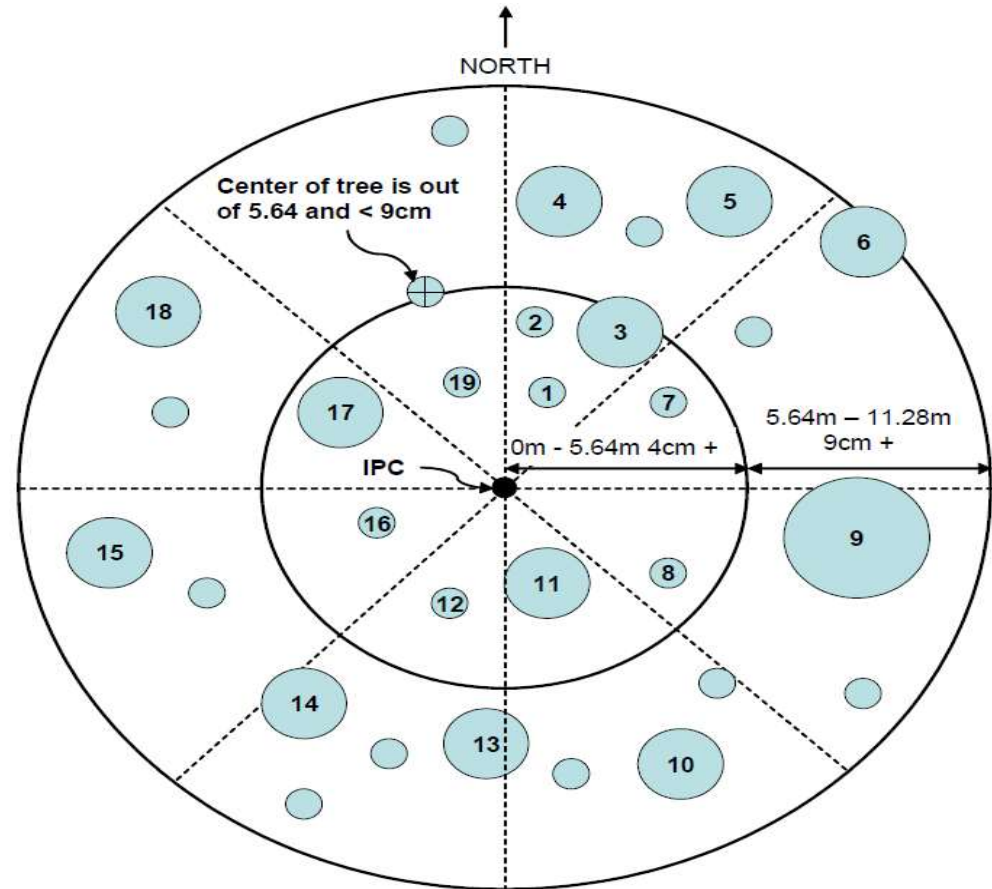
**Optional, and multiple available to be added and named

Definitions:

Start: From IPC looking out, along transect

Mirrored: From IPC looking out, 180 deg. from transect bearing

End: From end of transect looking in towards IPC



CMI - 5.64m and 11.28m Fixed Radius Plot Layout

EFR Key Guide

MAIN SCREENS

| | | | |
|---------|------------------------------|------------|--|
| F1 | Form Commands/Tools | All | Leads to other options, shows F commands available, tools menu |
| F2 | Inactive | | |
| F3 | Copy down | Any List | Copies down the data from the row above. |
| F4 | Next section | Trees | Move to the next section on screen |
| F5 | Toggle tree view | Trees | Toggles between Tree List and Tree Details screen |
| F6 | Toggle tree lists | Tree List | Toggles between tree, loss, damage and grade |
| F7 | Inactive | | |
| F8 | Inactive | | |
| F9 | Inactive | | |
| F10 | History view (remeasure, QA) | Most Forms | Toggles to 'previous' data for that screen |
| F11 | Inactive | | |
| F12 | Comments | Most Forms | Add a comment to the current screen |
| [ESC] | Escape Screen | All | Return to previous screen |
| [ENTER] | Enter/activate cell | All | |
| [TAB] | Next cell | All | |
| [SPACE] | Drop-down lists | Any List | Opens box drop-down lists (e.g. L/S/D/F, M/E, CC) |
| [ZERO] | Edit alpha cells | Any List | Allows editing in alpha cells; cursor enters cell |
| CTRL-F5 | Sample tree | Trees | Toggles between Sample Tree and Tree screen |
| CTRL-A | Stem Map Only | Tree List | Locks screen for azimuth and distance only |
| CTRL-G | "Go to" | Tree List | Search and go to a tree or sector |
| CTRL-L | Delete Row/Tree | Any List | Deletes the current row you are on |
| CTRL-N | Insert Row/Tree | Any List | Inserts a row after the current one you are on |
| CTRL-S | Save | All | Saves at any time without exiting the screen |
| CTRL-Z | Undo | Most Forms | Deletes the most recent change to data |
| CTRL- . | Hotkey | Trees | Press to select default values as follows: |
| | | | Live/Dead/Standing/Fallen = L/S, |
| | | | Measured/Estimated (DBH) = M, Measured/Estimated (ht) = M, |
| | | | Broken Top = No |
| | | | NF % = 100 |

EFR Key Guide

| TREE DETAILS SCREEN | | | |
|------------------------------|---------------|---------|---|
| Same as 'MAIN SCREEN' except | | | |
| F8 (SHIFT-F2) | Previous Tree | Details | Moves from current tree to previous in list |
| F9 (SHIFT-F3) | Next Tree | Details | Moves from current tree to next in list |
| F3 | Add Tree | Details | Adds a tree, highest tree number +1 |

| SAMPLE TREE SUMMARY | | | |
|----------------------|--------------------|------------------|--|
| F2 | Suggest samples | Sample Tree List | Sample tree screen shows trees identified as sample trees. F2 shows additional suggestions |
| | | | |
| SMALL TREE SCREEN | | | |
| F7 | 10-29cm column | Sm. Tree | Goes to 10-29cm column on current row |
| F8 | 30-130cm column | Sm. Tree | Goes to 30-130cm column on current row |
| F9 | >130cm column | Sm. Tree | Goes to >130cm column on current row |
| F6 | Toggles add/remove | Sm. Tree | F6 changes ENTER to subtract or add by 1 |
| [ENTER] | Add Tree to Cell | Sm. Tree | Adds tree(s) to the current cell |
| | | | |
| ACCESS SCREEN | | | |
| F2 | Reset row to 0 | Access | Resets current row cum. and inter. distance to 0 |
| F3 | Insert Above | Access | Adds and enters a row above current row |
| F4 | Next Section | Access | Skips to com |
| F5 | Insert below | Access | Adds and enters a row below current row |
| F6 | Delete | Access | Deletes current row |
| | | | |
| TREE SHRUB HERB MOSS | | | |
| F5 | Toggle Screen | Tree Shrub | Toggles between Tree/Shrub and Herb/Moss screen |
| | | | |
| TRANSECTS | | | |
| F6 | Toggle Screen | Transect | Toggles between transect 1 and 2 |

| Loss Indicator Codes | |
|----------------------|---|
| Code | Description |
| DD — | Unknown stem decay (conk) |
| | DDE is a known stem decay (<i>Echinodontium tinctorium</i>) |
| DR — | Unknown root decay |
| | DRA is a known root decay (<i>Armillaria ostoyae</i>) |
| BNK | Blind Conk |
| NGC | Frost Crack |
| SCA | Scar |
| FRK | Fork |
| CRO | Crook |
| LRB | Large Rotten Branch |
| DTP | Dead Top |
| BTP | Broken Top |
| SNG | Sounding |
| OTH | Other (cause is known, but no appropriate code) |
| DIR | Direct observation |

| Stand Disturbance Codes - CMI Header | |
|--------------------------------------|---|
| Code | Description |
| N | Non-biological/ abiotic injuries |
| NB | Fire |
| NW | Windthrow |
| DD | Heartrots |
| DF | Foliage diseases |
| DR | Root diseases |
| D | Unknown diseases |
| I | Unknown insects |
| IB | Bark beetles |
| ID | Insect defoliators |
| A | Animal |
| L | Logging, thinning, clearing, brushing and weeding - cut |
| X | Other known (add details in comments) |
| U | Other unknown |
| O | No significant damage |

| Loss Indicator Position Codes (PSPs ONLY) | |
|---|-------------------------------|
| Code | Position on Tree |
| | (tree is divided into thirds) |
| 1 | Lower third |
| 2 | Middle third |
| 3 | Upper third |
| 4 | Lower and middle third |
| 5 | Middle and upper third |
| 6 | Lower and upper third |
| 7 | All thirds |

| Loss Indicator Position (PSPs ONLY) | | | | | | | |
|-------------------------------------|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Top | | | √ | | √ | √ | √ |
| Middle | | √ | | √ | √ | | √ |
| Bottom | | | | √ | | √ | √ |

Tree Species List

| Code | Common Name | Latin Name |
|-------------------|-----------------------|--|
| Coniferous | | |
| Ba | Amabilis fir | <i>Abies amabilis</i> |
| Bg | Grand fir | <i>Abies grandis</i> |
| Bl | Subalpine fir | <i>Abies lasiocarpa</i> |
| Cw | Western red cedar | <i>Thuja plicata</i> |
| Fd | Douglas fir | <i>Pseudotsuga menziesii</i> |
| Fdi | interior Douglas fir | <i>Pseudotsuga menziesii</i> var. <i>glauca</i> |
| Fdc | coastal Douglas fir | <i>Pseudotsuga menziesii</i> var. <i>menziesii</i> |
| Hm | Mountain hemlock | <i>Tsuga mertensiana</i> |
| Hw | Western hemlock | <i>Tsuga heterophylla</i> |
| Hxm | Mountain x western h | <i>Tsuga mertensiana</i> x <i>heterophylla</i> |
| Jr | Rocky Mtn. juniper | <i>Juniperus scopulorum</i> |
| Js | Seaside juniper | <i>Juniperus maritima</i> |
| La | Alpine larch | <i>Larix lyallii</i> |
| Lt | Tamarack | <i>Larix laricina</i> |
| Lw | Western larch | <i>Larix occidentalis</i> |
| Pa | Whitebark pine | <i>Pinus albicaulis</i> |
| Pf | Limber pine | <i>Pinus flexilis</i> |
| Pj | Jack pine | <i>Pinus banksiana</i> |
| Pl | Lodgepole pine | <i>Pinus contorta</i> |
| Pli | Lodgepole pine | <i>Pinus contorta</i> var. <i>latifolia</i> |
| Plc | Shore pine | <i>Pinus contorta</i> var. <i>contorta</i> |
| Pw | Western white pine | <i>Pinus monticola</i> |
| Py | Ponderosa pine | <i>Pinus ponderosa</i> |
| Pxj | Lodgepole x jack pine | <i>Pinus</i> x <i>murraybanksiana</i> |
| Sb | Black spruce | <i>Picea mariana</i> |
| Se | Engelmann Pruce | <i>Picea engelmannii</i> |
| Ss | Sitka spruce | <i>Picea sitchensis</i> |
| Sw | White spruce | <i>Picea glauca</i> |
| Sx | Spruce hybrid | <i>Picea cross</i> |

| Code | Common Name | Latin Name |
|----------------------------|----------------------|--|
| Coniferous (cont'd) | | |
| Sxw | Engelmann x white | <i>Picea engelmannii</i> x <i>glauca</i> |
| Sxl | Sitka x white | <i>Picea</i> x <i>lutzii</i> |
| Sxs | Sitka x unknown hybr | <i>Picea sitchensis</i> x ? |
| Tw | Western yew | <i>Taxus brevifolia</i> |
| Yc | Yellow cedar | <i>Chamaecyparis nootkatensis</i> |
| Xc | Unknown conifer | |
| Zc | Other conifer | |

| Deciduous | | |
|------------------|------------------------|--|
| Ac | Poplar | <i>Populus balsamifera</i> |
| Acb | Balsam poplar | <i>Populus balsamifera</i> ssp. <i>Balsamifera</i> |
| Act | Black cottonwood | <i>Populus balsamifera</i> ssp. <i>Trichocarpa</i> |
| Ax | Hybrid poplars | <i>Populus</i> sp. x <i>sp.</i> |
| At | Tembling aspen | <i>Populus tremuloides</i> |
| Dr | Red alder | <i>Alnus rubra</i> |
| Ea | Alask paper birch | <i>Betula neoalaskana</i> |
| Exp | Alaska x paper birch h | <i>Betula</i> x <i>winteri</i> |
| Ep | Paper birch | <i>Betula papyrifera</i> |
| Ew | Water birch | <i>Betula occidentalis</i> |
| Mb | Bigleaf maple | <i>Acer macrophyllum</i> |
| Mv | Vine maple | <i>Acer circinatum</i> |
| Qg | Garry oak | <i>Quercus garryana</i> |
| Vb | Bitter cherry | <i>Prunus emarginata</i> |
| Vy | Choke cherry | <i>Prunus virginiana</i> |
| Vp | Pin cherry | <i>Prunus pensylvanica</i> |
| Xh | Unknown hardwood | |
| Zh | Other hardwood | |

| Damage Agent Codes | | | |
|--------------------|---|-----|--|
| Field Codes | | | Common Name |
| O | NO detectable abiotic or biotic damage | | |
| U | UNKNOWN (Damage evident but causal agent unknown) | | |
| * | UBT | | Unknown Broken Top |
| * | UCR | | Unknown Crook |
| * | UF | | Unknown Fork |
| * | USW | | Unknown Sweep |
| N | NON-BIOLOGICAL (ABIOTIC) INJURIES | | |
| | | NAV | Avalanche or Snow Slide |
| * | NB | | Fire |
| * | | NBP | Post Burn Mortality |
| * | | NCA | Aspen (At) Decline |
| * | | NCB | Birch (E) Decline |
| * | | NCY | Yellow Cedar (Yc) Decline |
| | ND | | Drought |
| | NF | | Flooding |
| | NG | | Frost |
| * | | NGC | Frost Crack |
| | | NGK | Shoot/Bud Frost Kill |
| | NH | | Hail |
| | NL | | Lightning |
| | NS | | Slide |
| * | NW | | Windthrow |
| * | | NWS | Windthrow - Soil Failure |
| * | | NWT | Windthrow - Treatment or Harvest-related |
| * | NX | | Wind Scarring or Rubbing |
| | NY | | Snow or Ice Damage |
| | | NYB | Snow or Ice Breakage |
| | | NYP | Snow Press |
| | NZ | | Sunscauld |

| Damage Agent Codes | | |
|--------------------|---------------------------|---------------------------------------|
| Field Codes | | Common Name |
| T | TREATMENT INJURIES | |
| | TC | Chemical Injury |
| * | TH | Harvested or Cut |
| * | TL | Logging Wounds |
| | TM | Other Mechanical Damage (non-logging) |
| | TR | Pruning Wound |
| | TT | Thinning or Spacing Wound |
| V | PROBLEM VEGETATION | |
| | VS | Shrub Competition |
| * | VT | Tree Competition |
| A | ANIMAL DAMAGE | |
| | AB | Bear |
| | AD | Deer |
| | AE | Elk |
| | AH | Hare or Rabbit |
| * | AM | Moose |
| | AP | Porcupine |
| * | AS | Squirrel |
| | AX | Bird |
| | AZ | Beaver |

* Denotes highest priority damage agents

| Damage Agent Codes | | | | |
|--|----------|-----|--------------------------------------|--|
| Field Codes | | | Common Name | Scientific Name |
| D | DISEASES | | | |
| | DB | | Broom Rusts | |
| | | DBF | Fir Broom Rust | <i>Melampsorella caryophyllacearum</i> |
| | | DBS | Spruce Broom Rust | <i>Chrysomyxa arctostaphyli</i> |
| | DD | | Stem Decay | |
| * | | DDB | Birch Trunk Rot | <i>Fomes fomentarius</i> |
| | | DDC | Brown Cubical Rot of Birch | <i>Piptoporus betulinus</i> |
| * | | DDE | Rust Red Stringy Rot | <i>Echindontium tinctorium</i> |
| * | | DDF | Brown Crumbly Rot | <i>Fomitopsis pinicola</i> |
| * | | DDG | Sterile Conk Trunk Rot of Birch | <i>Inonotus obliquus</i> |
| * | | DDH | Hardwood Trunk Rot | <i>Phellinus ignarius</i> |
| * | | DDP | Red Ring Rot | <i>Phellinus pini</i> |
| | | DDQ | Quinine Conk Rot | <i>Fomitopsis officinalis</i> |
| * | | DDT | Aspen Trunk Rot | <i>Phellinus tremulae</i> |
| | DF | | Foliage Diseases | |
| | | DFA | Western pine Aster Rust | <i>Coleosporium asterum</i> |
| | | DFB | Delphinella Tip Blight | <i>Delphinella spp.</i> |
| | | DFC | Large-spore Spruce-Labrador tea Rust | <i>Chrysomyxa ledicola</i> |
| | | DFD | Spruce Needle Cast | <i>Lirula macrospora</i> |
| * | | DFE | Elytroderma Needle Cast | <i>Elytroderma deformans</i> |
| | | DFF | Marssonina Leaf Blights | <i>Marssonina spp.</i> |
| | | DFG | Cottonwood Leaf Rust | <i>Melampsora occidentalis</i> |
| | | DFH | Larch Needle Blight | <i>Hypodermella laricis</i> |
| | | DFI | Linospora Leaf Blotch | <i>Linospora tetraspora</i> |
| | | DFK | Septoria Leaf Spot | <i>Septoria populicola</i> |
| * | | DFL | Pine Needle Cast | <i>Lophodermella concolor</i> |
| | | DFM | Larch Needle Cast | <i>Meria laricis</i> |
| | | DFP | Fir Fireweed Rust | <i>Pucciniastrum epilobi</i> |
| | | DFQ | Alpine Fir Needle Cast | <i>Isthmiella quadrispora</i> |
| | | DFR | Douglas-fir needle cast | <i>Rhabdocline pseudotsugae</i> |
| * | | DFS | Dothistroma Needle Blight | <i>Dothistroma septosporum</i> |
| | | DFU | Cedar Leaf Blight | <i>Didymascella thujina</i> |
| | | DFW | Swiss Needle Cast | <i>Phaeocryptopus gaumanni</i> |
| | | DFX | Brown Felt Blight | <i>Herpotrichia spp.</i> |
| * Denotes highest priority damage agents | | | | |

| Damage Agent Codes | | | | |
|--------------------|----------|-----|------------------------------------|-------------------------------------|
| Field Codes | | | Common Name | Scientific Name |
| D | DISEASES | | | |
| | DL | | Disease Caused Dieback | |
| | | DLV | Aspen-Poplar Twig Blight | <i>Venturia spp.</i> |
| | DM | | Dwarf Mistletoe | |
| | | DMF | Douglas-fir Dwarf Mistletoe | <i>Arceuthobium douglasii</i> |
| | | DMH | Hemlock Dwarf Mistletoe | <i>Arceuthobium tsugense</i> |
| | | DML | Larch Dwarf Mistletoe | <i>Arceuthobium laricis</i> |
| * | | DMP | Lodgepole pine Dwarf Mistletoe | <i>Arceuthobium americanum</i> |
| | DR | | Root Disease | |
| * | | DRA | Armillaria Root Disease | <i>Armillaria ostoyae</i> |
| | | DRB | Black Stain Root Disease | <i>Leptographium wageneri</i> |
| * | | DRL | Laminated Root Rot (Fd form) | <i>Inonotus sulphurascens</i> |
| | | DRN | Annosus Root Disease | <i>Heterobasidion annosum</i> |
| * | | DRS | Schweinitzii Butt Rot | <i>Phaeolus schweinitzii</i> |
| * | | DRT | Tomentosus Root Rot | <i>Inonotus tomentosus</i> |
| | DS | | Stem Diseases (Cankers and Rusts) | |
| * | | DSA | Atropellis Canker (Lodgepole pine) | <i>Atropellis piniphila</i> |
| | | DSB | White pine Blister Rust | <i>Cronartium ribicola</i> |
| * | | DSC | Comandra Blister Rust | <i>Cronartium comandrae</i> |
| | | DSE | Sooty Bark Canker | <i>Encoelia pruinosa</i> |
| * | | DSG | Western Gall Rust | <i>Endocronartium harknessii</i> |
| | | DSH | Hypoxylon Canker | <i>Entoleuca Hypoxylon mammatum</i> |
| | | DSP | Cryptosphaeria Canker | <i>Cryptosphaeria populina</i> |
| | | DSR | Ceratocystis Canker | <i>Ceratocystis fimbriata</i> |
| * | | DSS | Stalactiform Blister Rust | <i>Cronartium coleosporioides</i> |
| | | DSY | Cytospora Canker | <i>Cytospora chrysosperma</i> |
| I | INSECTS | | | |
| | IA | | Aphids | |
| | | IAB | Balsam Woolly Adelgid | <i>Adelges piceae</i> |
| | | IAG | Cooley Spruce Gall Adelgid | <i>Adelges cooleyi</i> |
| | | IAS | Green Spruce Aphid | <i>Elatobium abietinum</i> |
| | IB | | Bark Beetles | |
| | | IBB | Western Balsam Bark Beetle | <i>Dryocoetes confusus</i> |
| | | IBD | Douglas-fir Beetle | <i>Dendroctonus pseudotsugae</i> |
| | | IBF | Fir Engraver Beetle | <i>Scolytus ventralis</i> |

| Damage Agent Codes | | | | |
|--------------------|---------|-----|--------------------------------|---------------------------------------|
| Field Codes | | | Common Name | Scientific Name |
| I | INSECTS | | | |
| | IB | | Bark Beetles | |
| | | IBH | Hylurgops Beetle | <i>Hylurgops rugipennis</i> |
| | | IBI | Engraver Beetles | <i>Ips spp.</i> |
| * | | IBM | Mountain Pine Beetle | <i>Dendroctonus ponderosae</i> |
| | | IBP | Twig Beetles | <i>Pityogenes, Pityophthorus spp.</i> |
| | | IBS | Spruce Beetle | <i>Dendroctonus rufipennis</i> |
| | | IBW | Western Pine Beetle | <i>Dendroctonus brevicomis</i> |
| | ID | | Defoliators | |
| | | IDB | Two-year Budworm | <i>Choristoneura biennis</i> |
| | | IDE | Eastern Spruce Budworm | <i>Choristoneura fumiferana</i> |
| * | | IDF | Forest Tent Caterpillar | <i>Malacosoma disstria</i> |
| | | IDI | Pine Needle Sheath Miner | <i>Zellaria haimbachi</i> |
| * | | IDK | Northern Tent Caterpillar | <i>Malacosoma californicum</i> |
| * | | IDL | Western Hemlock Looper | <i>Lambdina fiscellaria lugubrosa</i> |
| | | IDN | Birch Leaf Miner | <i>Fenusa pusilla</i> |
| | | IDP | Larch Sawfly | <i>Pristophora erichsoni</i> |
| | | IDT | Douglas-fir Tussock Moth | <i>Orgyia pseudotsugata</i> |
| | | IDU | Satin Moth | <i>Leucoma salicis</i> |
| * | | IDW | Western Spruce Budworm | <i>Choristoneura occidentalis</i> |
| * | | ID6 | Aspen Leaf Miner | <i>Phyllocristis populiella</i> |
| | | IEA | Unidentified Aspen Defoliation | |
| | IS | | Shoot Insects | |
| | | ISA | Bronze Birch Borer | <i>Agrilus anxius</i> |
| * | | ISC | Poplar Borer | <i>Saperda calcarata</i> |
| | | ISG | Gouty Pitch Midge | <i>Cecidomyia piniinopsis</i> |
| * | | ISP | Pitch Nodule Moths | <i>Petrova spp.</i> |
| * | | ISQ | Sequoia Pitch Moth | <i>Vespamima sequoiae</i> |
| | | ISW | Poplar and Willow Borer | <i>Cryptorhynchus lapathi</i> |
| | IW | | Weevils | |
| * | | IWP | Lodgepole pine Terminal Weevil | <i>Pissodes terminalis</i> |
| * | | IWS | White pine Weevil (on Spruce) | <i>Pissodes strobi</i> |
| | | IWW | Warren’s Root Collar Weevil | <i>Hylobius warreni</i> |
| | | IWZ | Yosemite Bark Weevil | <i>Pissodes schwartzii</i> |

* Denotes highest priority damage agents

Common Conifer Forest Health Factors by BEC Zone - For Stands >15 Years (Updated T9/T10)

| Biogeoclimatic Zone | | | | | | | | | | | | | | | | | | | | | | | |
|---------------------|---|-----|-----|-----|-----|------|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|-----|------|-------|------|-----|-----|-----|
| BWBS | | CDF | | CWH | | ESSF | | ICH | | IDF | | MH | | MS | | PP | | SBPS | | SBS | | SWB | |
| IB* | m | DRL | m,g | DRL | m,g | IB* | m | IB* | m | IB* | m | DRL | m,g | IB* | m | IB* | m | IB* | m | IB* | m | IB* | m |
| IDE | g | DRA | m,g | DRA | m,g | NAV | m | DRA | m,g | NB | m,g | DMH | g,m | NB | m,g | IBW | m | NB | m,g,q | DRA* | m,g | DSG | m,g |
| IDB | g | NW | m | NW | m | NY | m,q | DRL | m,g | DRA | m,g | NCY | g,m | DRA | m,g | NB | m,g | DSC | m | DRL* | m,g | DRT | g,m |
| IWS | q | ND | m | DSB | m | DRA | m,g | AB | g,m | DRL | m,g | DDP | d | DRL | m,g | DRA | m,g | DSS | m,g | DRT | g,m | NY | q |
| DDP | d | DSB | m | ND | m | ND | g,m | DRT | g,m | DSB | m | DB | q | DRT | g,m | DSG | m,q | ND | m,g | NB | g,m | AP | q |
| DB | q | DMH | g,m | DRN | g,m | DSG | m,q | DSB | m | DSC | m | NY | g,q | DSB | m | IDW | g,m | DFE | g,m,q | DSC | m | DB | q |
| | | DFU | g,m | DMH | g,m | DDP | d | DSC | m,g | DSS | m,g | | | DSC | m | DDP | d | DSG | m,q | DSB* | m | NG | q |
| | | DFW | g | NCY | g,m | DDE | d | DSS | m,g | DSG | m,g | | | DSS | m,g | | | DMP | g,m,q | DSS | m,g | | |
| | | DDP | d | IDH | g | IWS | q | DSG | m,q | IDW | g,m | | | DSG | m,g | | | DSA | q,m | DSG | m,q | | |
| | | | | IWS | g | WS | g | IDL | g,m | DML | g,m | | | DMP | g,m | | | DFL | g | DMP | g,m | | |
| | | | | DFW | g | DB | q | IWS | g,q | DFE | g,m,q | | | IWS | g,q | | | IDI | g | IDB | g | | |
| | | | | DFU | g | | | DFS | g,m | DFL | g | | | DML | g,m | | | IWP | q | DFS | g | | |
| | | | | DDP | d | | | DML | g,m | IDI | g | | | IDI | g | | | ISP | q | NY | g | | |
| | | | | AB | g,q | | | DFL | g | DFH | g | | | DFL | g | | | DB | q | DFE | g | | |
| | | | | AE | q | | | DFH | g | DFM | g | | | DFH | g | | | AS | q | IWS | g,q | | |
| | | | | | | | | DFM | g | WS | g | | | DFM | g | | | | | DFL | g | | |
| | | | | | | | | DDE | d | DDP | d | | | WS | g | | | | | IDI | g | | |
| | | | | | | | | DDP | d | DDQ | d | | | DSA | q | | | | | IWP | q | | |
| | | | | | | | | DSA | q | DSA | q | | | DDP | d | | | | | DDP | d | | |
| | | | | | | | | ISP | q | ISP | q | | | IWP | q | | | | | DSA | q | | |
| | | | | | | | | DB | q | DB | q | | | ISP | q | | | | | ISP | q | | |
| | | | | | | | | | | | | | | DB | q | | | | | DB | q | | |

Notes:

- 1) The damage agent codes are listed by BEC zone in order of typically decreasing relative importance, but the order may vary depending on forest health factor severity and prevalence.
- 2) The two or three letter damage agent codes are followed by lower case "impact" qualifiers/descriptors:
 - **m** = mortality; **g** = growth reduction; **d** = decay; **q** = quality.
 - These are listed next to each damage agent in order of their primary effect on a host.
- 3) IB* indicates major bark beetle species only (IBB, IBD, IBM, and IBS).
- 4) ** denotes that the damage agent is restricted to the southern SBS only.

| Damage Severity and Mortality Condition Codes and Standards | | |
|---|---|--|
| Damage /condition or agent | Severity code | Code Description |
| Unknown Forks (UF) and Unknown Crooks (UCR) | M | Major fork or crook <i>(** see below for key info)</i> |
| | N | Minor fork or Crook <i>(** see below for key info)</i> |
| Bark Beetles | FA | Failed Attack |
| | GR | Current (Green) Attack |
| | RA | Red Attack |
| | GY | Grey Attack |
| Defoliators, needle rusts and blights (total crown rating scale; past and present attack) | % defoliated, discoloured, or infected | Enter % (1-100) |
| Defoliators - Western Spruce Budworm (current foliage only) | % of current year's foliage defoliated | Enter % (1-100) |
| Defoliators - Elytroderma Needle Cast | Codes: 1, 2, 3, 4, 5, 6 | Hawskworth's 6-class rating system |
| Dwarf Mistletoes (for all species) | Codes: 1, 2, 3, 4, 5, 6 | Hawskworth's 6-class rating system |
| Broom Rusts | Codes: 1, 2, 3, 4, 5, 6 | Hawskworth's 6-class rating system |
| Terminal Weevils | Record: | |
| | C | Current attack only (no previous attack) |
| | O | Old attack (may also be current attack) |
| | and: below for 'O' only, if 'C' no further code allowed | |
| | M | Major crook |
| | N | Minor crook |
| | F | Forking |
| | S | Staghead |
| Stem rusts and cankers (see separate code table for YSM severities) | SC | Stem Canker(s) |
| | TK | Top-Kill |
| Root Rots | SC | Crown symptoms |
| | BR | Basal resinosis |
| | CS | Confirmatory symptoms (stain, decay, mycelia, rhizomorphs, or sporophores) |
| Mammals, birds and root collar weevil (girdlers) | % girdled | Enter % girdled at site of damage |
| Drought, Shoot/bud frost kill, Fumekill, Road salt, Red belt | % live crown affected | Enter % (1-100) |
| Wind scarring and Sunscald | % circumference | Enter % of circumference damaged |
| Lightning | % of length | Enter % of bole length damaged |

| ** Severity Ratings for UF and UCR |
|--|
| M (major): offset from the main stem is >= 50% |
| N (minor): offset from the main stem is < 50% |
| NOTE: Any FRK or CRO that occurs in the portion of the main stem that is < 10 cm diameter is automatically an N (minor) severity |
| NOTE: Select the severity that corresponds to the <u>most</u> severe occurrence of a UF and/or UCR |
| Incidences to Ignore: (Do NOT call a FRK or CRO loss indicator for the following) |
| Potential FRK to be <i>ignored</i> : Spike branch with no to very little diameter loss or offset (~ < 10%) |
| Potential CRO to be <i>ignored</i> : Very little diameter loss or offset (~ < 10%) |

| Severity Codes for Rust and Canker Measurements (YSM only) | | | |
|--|------------------|---------------------------|------------------|
| Infection Height (1st digit) | | %Encirclement (2nd digit) | |
| Severity Code | Height Range (m) | Severity Code | Encirclement (%) |
| 0 | 0.0 - 0.5 | 0 | 1 - 5 |
| 1 | 0.6 - 1.5 | 1 | 5 - 15 |
| 2 | 1.6 - 2.5 | 2 | 16 - 25 |
| 3 | 2.6 - 3.5 | 3 | 26 - 35 |
| 4 | 3.6 - 4.5 | 4 | 36 - 35 |
| 5 | 4.6 - 5.5 | 5* | 46 - 55 |
| 6 | 5.6 - 6.5 | 6 | 56 - 65 |
| 7 | 6.6 - 7.5 | 7 | 66 - 75 |
| 8 | 7.6 - 8.5 | 8 | 76 - 85 |
| 9 | 8.6 + | 9 | 86 - 100 |

* significant break point

| Severity Codes for Fire | | | |
|-------------------------------|--|-----------------------------|-----------------------|
| Wood Fibre Damage (1st digit) | | % Foliar Scorch (2nd digit) | |
| Code | Description | Code | Description |
| A | Cambial damage (i.e., more than scorched bark, but less than charred wood of a significant depth) | 0 | 0% (no foliar scorch) |
| | | 1 | 1 - 15% |
| | | 2 | 16 - 25% |
| B | Minor wood fibre damage (i.e., localized shallow charring) | 3 | 26 - 35% |
| | | 4 | 36 - 45% |
| C | Major wood fibre damage (i.e., extensive shallow charring or localized or extensive deep charring) | 5 | 46 - 55% |
| | | 6 | 56 - 65% |
| | | 7 | 66 - 75% |
| O | No cambial or wood fibre damage | 8 | 76 - 85% |
| | | 9 | 86 - 100% |


Hawskworth Scale for Elytroderma, Mistletoe Infection and Broom Rusts

Step 1: Divide live crown into thirds according to stem length

Step 2: Rate each third separately. Give each third a rating of either as described below:

(0) No visible infection
(1) Light infection (1/2 or less of branches in the third infected)
(2) Heavy infection (more than 1/2 of branches in third infected)

Step 3:



Example

If this third has no visible infections, its rating is (0).

If this third is lightly infected, its rating is (1).

If this third is heavily infected, its rating is (2).

The tree in this example gets a rating of: 0 + 1 + 2 = 3.

| Slope(%) | Factor |
|----------|--------|
| 1 | 1 |
| 2 | 1 |
| 3 | 1 |
| 4 | 0.999 |
| 5 | 0.999 |
| 6 | 0.998 |
| 7 | 0.998 |
| 8 | 0.997 |
| 9 | 0.996 |
| 10 | 0.995 |
| 11 | 0.994 |
| 12 | 0.993 |
| 13 | 0.992 |
| 14 | 0.990 |
| 15 | 0.989 |
| 16 | 0.987 |
| 17 | 0.986 |
| 18 | 0.984 |
| 19 | 0.982 |
| 20 | 0.981 |
| 21 | 0.979 |
| 22 | 0.977 |
| 23 | 0.975 |
| 24 | 0.972 |
| 25 | 0.970 |
| 26 | 0.968 |
| 27 | 0.965 |
| 28 | 0.963 |
| 29 | 0.960 |
| 30 | 0.958 |
| 31 | 0.955 |
| 32 | 0.952 |
| 33 | 0.950 |

| Slope(%) | Factor |
|----------|--------|
| 34 | 0.947 |
| 35 | 0.944 |
| 36 | 0.941 |
| 37 | 0.938 |
| 38 | 0.935 |
| 39 | 0.932 |
| 40 | 0.928 |
| 41 | 0.925 |
| 42 | 0.922 |
| 43 | 0.919 |
| 44 | 0.915 |
| 45 | 0.912 |
| 46 | 0.908 |
| 47 | 0.905 |
| 48 | 0.902 |
| 49 | 0.898 |
| 50 | 0.894 |
| 51 | 0.891 |
| 52 | 0.887 |
| 53 | 0.884 |
| 54 | 0.880 |
| 55 | 0.876 |
| 56 | 0.873 |
| 57 | 0.869 |
| 58 | 0.865 |
| 59 | 0.861 |
| 60 | 0.857 |
| 61 | 0.854 |
| 62 | 0.850 |
| 63 | 0.846 |
| 64 | 0.842 |
| 65 | 0.838 |
| 66 | 0.835 |

| Slope(%) | Factor |
|----------|--------|
| 67 | 0.831 |
| 68 | 0.827 |
| 69 | 0.823 |
| 70 | 0.819 |
| 71 | 0.815 |
| 72 | 0.812 |
| 73 | 0.808 |
| 74 | 0.804 |
| 75 | 0.800 |
| 76 | 0.796 |
| 77 | 0.792 |
| 78 | 0.789 |
| 79 | 0.785 |
| 80 | 0.781 |
| 81 | 0.777 |
| 82 | 0.773 |
| 83 | 0.769 |
| 84 | 0.766 |
| 85 | 0.762 |
| 86 | 0.758 |
| 87 | 0.754 |
| 88 | 0.751 |
| 89 | 0.747 |
| 90 | 0.743 |
| 91 | 0.740 |
| 92 | 0.736 |
| 93 | 0.732 |
| 94 | 0.729 |
| 95 | 0.725 |
| 96 | 0.721 |
| 97 | 0.718 |
| 98 | 0.714 |
| 99 | 0.711 |

| Slope(%) | Factor |
|----------|--------|
| 100 | 0.707 |
| 101 | 0.704 |
| 102 | 0.700 |
| 103 | 0.697 |
| 104 | 0.693 |
| 105 | 0.690 |
| 106 | 0.686 |
| 107 | 0.683 |
| 108 | 0.679 |
| 109 | 0.676 |
| 110 | 0.673 |
| 111 | 0.669 |
| 112 | 0.666 |
| 113 | 0.663 |
| 114 | 0.659 |
| 115 | 0.656 |
| 116 | 0.653 |
| 117 | 0.650 |
| 118 | 0.647 |
| 119 | 0.643 |
| 120 | 0.640 |
| 121 | 0.637 |
| 122 | 0.634 |
| 123 | 0.631 |
| 124 | 0.628 |
| 125 | 0.625 |
| 126 | 0.622 |
| 127 | 0.619 |
| 128 | 0.616 |
| 129 | 0.613 |
| 130 | 0.609 |
| 131 | 0.607 |
| 132 | 0.604 |

| Slope(%) | Factor |
|----------|--------|
| 133 | 0.601 |
| 134 | 0.598 |
| 135 | 0.595 |
| 136 | 0.592 |
| 137 | 0.590 |
| 138 | 0.587 |
| 139 | 0.584 |
| 140 | 0.581 |
| 141 | 0.578 |
| 142 | 0.576 |
| 143 | 0.573 |
| 144 | 0.570 |
| 145 | 0.568 |
| 146 | 0.565 |
| 147 | 0.562 |
| 148 | 0.560 |
| 149 | 0.557 |
| 150 | 0.555 |

Calculating the slope correction factor:
 $\text{COS}[\text{TAN}^{-1}(\text{Slope\%/100})] = \text{factor}$

| Seeds 1 to 50 | Random Bearing | Random Bearing +90 | Randomized numbers 1 - 20 (left to right) | | | | | | | | | | | | | | | Randomized numbers from 1 to 100 (top to bottom) | | | | | ↓ |
|---------------|----------------|--------------------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|----|----|----|----|----|
| 1 | 23 | 113 | 14 | 12 | 18 | 8 | 20 | 7 | 19 | 3 | 10 | 15 | 11 | 13 | 16 | 5 | 1 | 17 | 6 | 2 | 9 | 4 | 58 |
| 2 | 155 | 245 | 1 | 11 | 17 | 13 | 16 | 8 | 5 | 20 | 9 | 2 | 14 | 6 | 12 | 15 | 10 | 4 | 19 | 7 | 3 | 18 | 7 |
| 3 | 350 | 80 | 4 | 5 | 7 | 19 | 17 | 20 | 2 | 9 | 11 | 14 | 18 | 3 | 6 | 10 | 1 | 8 | 12 | 13 | 15 | 16 | 38 |
| 4 | 296 | 26 | 1 | 7 | 4 | 15 | 6 | 10 | 20 | 13 | 2 | 17 | 12 | 18 | 19 | 5 | 16 | 14 | 3 | 9 | 8 | 11 | 85 |
| 5 | 8 | 98 | 17 | 1 | 5 | 19 | 8 | 11 | 9 | 15 | 4 | 13 | 6 | 12 | 10 | 7 | 3 | 18 | 20 | 2 | 16 | 14 | 36 |
| 6 | 304 | 34 | 18 | 7 | 2 | 1 | 14 | 3 | 5 | 4 | 11 | 15 | 8 | 9 | 20 | 17 | 10 | 12 | 19 | 16 | 6 | 13 | 33 |
| 7 | 351 | 81 | 10 | 6 | 1 | 13 | 9 | 8 | 11 | 17 | 19 | 3 | 16 | 20 | 5 | 4 | 15 | 18 | 2 | 12 | 7 | 14 | 53 |
| 8 | 158 | 248 | 19 | 4 | 16 | 20 | 2 | 11 | 10 | 8 | 5 | 13 | 12 | 1 | 14 | 15 | 9 | 6 | 17 | 18 | 7 | 3 | 78 |
| 9 | 139 | 229 | 14 | 11 | 5 | 2 | 18 | 7 | 19 | 16 | 13 | 1 | 20 | 3 | 4 | 6 | 9 | 17 | 12 | 10 | 8 | 15 | 40 |
| 10 | 33 | 123 | 17 | 15 | 14 | 18 | 5 | 1 | 7 | 19 | 2 | 6 | 3 | 8 | 9 | 4 | 10 | 20 | 13 | 16 | 12 | 11 | 56 |
| 11 | 264 | 354 | 15 | 3 | 11 | 20 | 1 | 10 | 19 | 4 | 12 | 5 | 16 | 7 | 18 | 6 | 14 | 2 | 17 | 8 | 9 | 13 | 32 |
| 12 | 278 | 8 | 5 | 8 | 16 | 6 | 7 | 17 | 11 | 9 | 15 | 14 | 19 | 20 | 10 | 3 | 2 | 12 | 4 | 13 | 18 | 1 | 87 |
| 13 | 137 | 227 | 2 | 10 | 5 | 15 | 12 | 20 | 17 | 4 | 1 | 13 | 14 | 18 | 9 | 16 | 19 | 8 | 11 | 3 | 6 | 7 | 83 |
| 14 | 243 | 333 | 14 | 5 | 3 | 4 | 1 | 10 | 15 | 13 | 19 | 20 | 2 | 12 | 11 | 7 | 16 | 6 | 8 | 18 | 17 | 9 | 67 |
| 15 | 176 | 266 | 15 | 7 | 19 | 11 | 9 | 6 | 8 | 3 | 12 | 10 | 14 | 1 | 2 | 4 | 18 | 5 | 16 | 13 | 17 | 20 | 18 |
| 16 | 267 | 357 | 19 | 16 | 3 | 7 | 17 | 1 | 20 | 2 | 12 | 15 | 18 | 8 | 11 | 9 | 4 | 14 | 6 | 13 | 10 | 5 | 31 |
| 17 | 214 | 304 | 6 | 7 | 12 | 14 | 3 | 16 | 8 | 13 | 1 | 20 | 19 | 2 | 5 | 9 | 10 | 15 | 18 | 11 | 4 | 17 | 75 |
| 18 | 229 | 319 | 13 | 8 | 12 | 18 | 14 | 10 | 15 | 3 | 5 | 20 | 4 | 11 | 1 | 17 | 16 | 6 | 9 | 2 | 19 | 7 | 79 |
| 19 | 257 | 347 | 17 | 5 | 19 | 12 | 8 | 18 | 3 | 2 | 15 | 16 | 4 | 6 | 20 | 14 | 9 | 10 | 13 | 11 | 7 | 1 | 89 |
| 20 | 324 | 54 | 14 | 8 | 15 | 4 | 6 | 19 | 16 | 1 | 12 | 2 | 17 | 3 | 10 | 11 | 20 | 5 | 9 | 13 | 18 | 7 | 96 |
| 21 | 98 | 188 | 10 | 16 | 19 | 15 | 1 | 8 | 18 | 14 | 9 | 11 | 4 | 2 | 12 | 7 | 13 | 17 | 5 | 6 | 20 | 3 | 12 |
| 22 | 70 | 160 | 15 | 19 | 14 | 1 | 6 | 18 | 12 | 4 | 2 | 5 | 9 | 17 | 20 | 16 | 3 | 10 | 11 | 7 | 13 | 8 | 14 |
| 23 | 161 | 251 | 9 | 10 | 14 | 18 | 17 | 15 | 4 | 2 | 11 | 16 | 7 | 12 | 6 | 8 | 20 | 1 | 19 | 13 | 5 | 3 | 6 |
| 24 | 199 | 289 | 5 | 4 | 12 | 1 | 7 | 10 | 20 | 14 | 19 | 9 | 15 | 11 | 16 | 18 | 3 | 13 | 8 | 2 | 17 | 6 | 72 |
| 25 | 329 | 59 | 14 | 9 | 7 | 3 | 17 | 15 | 18 | 1 | 4 | 16 | 6 | 10 | 12 | 20 | 19 | 2 | 5 | 8 | 13 | 11 | 63 |
| 26 | 110 | 200 | 20 | 11 | 9 | 13 | 15 | 6 | 2 | 8 | 7 | 10 | 4 | 14 | 19 | 12 | 3 | 17 | 18 | 16 | 1 | 5 | 45 |
| 27 | 127 | 217 | 5 | 4 | 9 | 15 | 18 | 2 | 19 | 16 | 17 | 11 | 1 | 20 | 8 | 13 | 3 | 12 | 10 | 6 | 7 | 14 | 41 |
| 28 | 253 | 343 | 3 | 2 | 10 | 14 | 15 | 19 | 6 | 13 | 18 | 5 | 4 | 20 | 8 | 1 | 9 | 16 | 7 | 12 | 17 | 11 | 69 |
| 29 | 314 | 44 | 5 | 3 | 18 | 14 | 1 | 6 | 2 | 13 | 10 | 20 | 4 | 8 | 15 | 9 | 16 | 19 | 11 | 17 | 12 | 7 | 66 |
| 30 | 285 | 15 | 20 | 10 | 11 | 14 | 15 | 18 | 17 | 9 | 2 | 7 | 1 | 3 | 5 | 19 | 8 | 13 | 16 | 4 | 12 | 6 | 48 |
| 31 | 87 | 177 | 5 | 6 | 13 | 7 | 12 | 1 | 20 | 4 | 2 | 14 | 11 | 15 | 9 | 3 | 16 | 17 | 19 | 8 | 18 | 10 | 27 |
| 32 | 277 | 7 | 2 | 1 | 8 | 14 | 18 | 9 | 7 | 12 | 20 | 15 | 19 | 4 | 6 | 3 | 5 | 17 | 16 | 10 | 11 | 13 | 47 |
| 33 | 109 | 199 | 14 | 5 | 20 | 2 | 10 | 4 | 18 | 15 | 13 | 9 | 16 | 19 | 1 | 11 | 3 | 17 | 12 | 6 | 7 | 8 | 26 |
| 34 | 332 | 62 | 7 | 13 | 10 | 9 | 18 | 16 | 11 | 2 | 3 | 6 | 5 | 4 | 20 | 14 | 15 | 8 | 1 | 12 | 17 | 19 | 99 |
| 35 | 67 | 157 | 3 | 10 | 11 | 15 | 2 | 14 | 7 | 8 | 19 | 18 | 16 | 5 | 17 | 13 | 12 | 6 | 1 | 4 | 20 | 9 | 74 |
| 36 | 74 | 164 | 2 | 10 | 13 | 6 | 14 | 1 | 5 | 7 | 12 | 19 | 18 | 3 | 17 | 11 | 4 | 15 | 8 | 20 | 16 | 9 | 73 |
| 37 | 283 | 13 | 16 | 13 | 19 | 14 | 1 | 15 | 12 | 18 | 6 | 7 | 5 | 20 | 9 | 17 | 2 | 3 | 4 | 8 | 10 | 11 | 10 |
| 38 | 32 | 122 | 18 | 16 | 20 | 10 | 17 | 5 | 12 | 4 | 15 | 14 | 11 | 9 | 7 | 1 | 2 | 3 | 6 | 13 | 8 | 19 | 59 |

HOW TO USE THIS TABLE: The last two digits of y r sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, continue across and down from previous selection.

| Seeds 1 to 50 | Random Bearing | Random Bearing +90 | Randomized numbers 1 - 20 (left to right) | | | | | | | | | | | | | | | | Randomized numbers from 1 to 100 (top to bottom) | | | | | | ↓ |
|---------------|----------------|--------------------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|----|----|----|----|--|---|
| 39 | 270 | 0 | 5 | 12 | 19 | 20 | 11 | 7 | 10 | 2 | 15 | 3 | 14 | 17 | 4 | 6 | 8 | 16 | 13 | 9 | 18 | 1 | 77 | | |
| 40 | 339 | 69 | 13 | 3 | 15 | 2 | 18 | 10 | 11 | 12 | 17 | 16 | 7 | 14 | 4 | 20 | 19 | 9 | 6 | 1 | 5 | 8 | 46 | | |
| 41 | 300 | 30 | 10 | 16 | 1 | 12 | 17 | 4 | 19 | 8 | 15 | 20 | 5 | 18 | 14 | 13 | 6 | 7 | 3 | 2 | 11 | 9 | 57 | | |
| 42 | 17 | 107 | 16 | 2 | 4 | 1 | 3 | 8 | 9 | 7 | 5 | 12 | 17 | 15 | 19 | 20 | 11 | 6 | 10 | 13 | 14 | 18 | 93 | | |
| 43 | 144 | 234 | 6 | 2 | 20 | 19 | 17 | 15 | 12 | 5 | 3 | 18 | 14 | 4 | 9 | 8 | 16 | 1 | 13 | 7 | 11 | 10 | 16 | | |
| 44 | 271 | 1 | 16 | 4 | 7 | 1 | 10 | 19 | 8 | 14 | 17 | 13 | 6 | 9 | 11 | 20 | 18 | 5 | 15 | 12 | 2 | 3 | 61 | | |
| 45 | 248 | 338 | 20 | 13 | 19 | 5 | 15 | 2 | 10 | 16 | 6 | 12 | 18 | 1 | 3 | 14 | 17 | 8 | 11 | 4 | 7 | 9 | 68 | | |
| 46 | 77 | 167 | 2 | 3 | 13 | 20 | 15 | 11 | 17 | 1 | 4 | 7 | 18 | 5 | 6 | 19 | 14 | 9 | 8 | 16 | 12 | 10 | 42 | | |
| 47 | 43 | 133 | 11 | 2 | 14 | 12 | 10 | 17 | 18 | 20 | 13 | 15 | 5 | 8 | 4 | 7 | 19 | 3 | 9 | 1 | 16 | 6 | 37 | | |
| 48 | 223 | 313 | 7 | 16 | 4 | 20 | 15 | 3 | 2 | 18 | 6 | 11 | 19 | 13 | 1 | 8 | 10 | 12 | 9 | 17 | 5 | 14 | 2 | | |
| 49 | 122 | 212 | 10 | 1 | 5 | 7 | 9 | 3 | 16 | 18 | 8 | 13 | 11 | 17 | 19 | 12 | 15 | 20 | 2 | 6 | 14 | 4 | 50 | | |
| 50 | 66 | 156 | 19 | 2 | 5 | 17 | 16 | 12 | 8 | 15 | 4 | 14 | 18 | 1 | 11 | 20 | 13 | 3 | 7 | 6 | 9 | 10 | 11 | | |
| 51 | 45 | 135 | 14 | 17 | 12 | 1 | 10 | 7 | 20 | 16 | 15 | 3 | 6 | 4 | 5 | 13 | 11 | 9 | 8 | 18 | 19 | 2 | 91 | | |
| 52 | 27 | 117 | 12 | 7 | 11 | 13 | 8 | 6 | 16 | 20 | 3 | 10 | 14 | 5 | 4 | 1 | 2 | 18 | 9 | 15 | 17 | 19 | 94 | | |
| 53 | 13 | 103 | 19 | 12 | 18 | 8 | 5 | 3 | 15 | 10 | 20 | 16 | 1 | 17 | 7 | 2 | 6 | 14 | 4 | 9 | 13 | 11 | 39 | | |
| 54 | 25 | 115 | 11 | 1 | 9 | 19 | 16 | 10 | 4 | 20 | 18 | 2 | 6 | 13 | 3 | 14 | 8 | 12 | 5 | 15 | 17 | 7 | 97 | | |
| 55 | 49 | 139 | 9 | 6 | 7 | 17 | 15 | 11 | 18 | 5 | 3 | 2 | 8 | 19 | 14 | 4 | 13 | 10 | 16 | 1 | 20 | 12 | 23 | | |
| 56 | 328 | 58 | 2 | 12 | 19 | 8 | 6 | 4 | 16 | 7 | 18 | 14 | 1 | 13 | 3 | 10 | 15 | 5 | 9 | 11 | 20 | 17 | 76 | | |
| 57 | 247 | 337 | 19 | 16 | 14 | 7 | 17 | 9 | 4 | 6 | 15 | 20 | 3 | 12 | 11 | 13 | 10 | 1 | 18 | 2 | 8 | 5 | 82 | | |
| 58 | 334 | 64 | 14 | 11 | 3 | 20 | 12 | 2 | 5 | 6 | 13 | 10 | 4 | 15 | 19 | 8 | 18 | 9 | 1 | 16 | 17 | 7 | 20 | | |
| 59 | 21 | 111 | 20 | 12 | 11 | 1 | 14 | 4 | 19 | 7 | 9 | 18 | 15 | 5 | 8 | 16 | 6 | 17 | 13 | 2 | 10 | 3 | 49 | | |
| 60 | 232 | 322 | 2 | 4 | 16 | 14 | 20 | 13 | 11 | 3 | 17 | 7 | 6 | 10 | 9 | 15 | 18 | 1 | 19 | 5 | 8 | 12 | 81 | | |
| 61 | 125 | 215 | 13 | 16 | 5 | 9 | 14 | 7 | 17 | 2 | 15 | 18 | 3 | 8 | 12 | 6 | 10 | 4 | 1 | 19 | 20 | 11 | 1 | | |
| 62 | 234 | 324 | 4 | 2 | 11 | 18 | 13 | 9 | 5 | 20 | 19 | 16 | 17 | 7 | 1 | 10 | 8 | 15 | 3 | 6 | 14 | 12 | 34 | | |
| 63 | 180 | 270 | 20 | 19 | 18 | 3 | 1 | 9 | 15 | 5 | 14 | 2 | 17 | 6 | 10 | 7 | 16 | 11 | 12 | 8 | 4 | 13 | 86 | | |
| 64 | 212 | 302 | 20 | 12 | 4 | 3 | 5 | 15 | 2 | 9 | 13 | 14 | 10 | 1 | 19 | 8 | 16 | 11 | 7 | 6 | 18 | 17 | 29 | | |
| 65 | 141 | 231 | 4 | 7 | 18 | 14 | 3 | 9 | 16 | 20 | 2 | 5 | 8 | 19 | 13 | 11 | 15 | 12 | 6 | 10 | 17 | 1 | 55 | | |
| 66 | 38 | 128 | 17 | 10 | 3 | 5 | 13 | 12 | 19 | 11 | 9 | 2 | 7 | 20 | 16 | 18 | 6 | 14 | 15 | 8 | 1 | 4 | 80 | | |
| 67 | 249 | 339 | 7 | 19 | 18 | 13 | 17 | 5 | 16 | 20 | 1 | 4 | 15 | 12 | 3 | 11 | 10 | 8 | 9 | 14 | 6 | 2 | 30 | | |
| 68 | 15 | 105 | 17 | 9 | 2 | 13 | 1 | 4 | 20 | 19 | 8 | 18 | 10 | 5 | 3 | 7 | 12 | 11 | 14 | 15 | 6 | 16 | 8 | | |
| 69 | 317 | 47 | 8 | 7 | 12 | 14 | 16 | 4 | 17 | 15 | 18 | 10 | 3 | 19 | 11 | 13 | 5 | 2 | 20 | 6 | 9 | 1 | 88 | | |
| 70 | 196 | 286 | 16 | 12 | 7 | 20 | 2 | 11 | 5 | 3 | 9 | 15 | 13 | 18 | 4 | 1 | 17 | 19 | 10 | 6 | 14 | 8 | 92 | | |
| 71 | 337 | 67 | 17 | 18 | 14 | 5 | 15 | 7 | 19 | 20 | 3 | 13 | 2 | 10 | 11 | 9 | 1 | 12 | 16 | 4 | 6 | 8 | 28 | | |
| 72 | 150 | 240 | 7 | 10 | 14 | 2 | 17 | 20 | 19 | 12 | 13 | 8 | 16 | 9 | 11 | 5 | 3 | 18 | 4 | 1 | 6 | 15 | 98 | | |
| 73 | 305 | 35 | 5 | 8 | 4 | 3 | 2 | 16 | 9 | 10 | 7 | 15 | 6 | 1 | 19 | 20 | 13 | 11 | 14 | 12 | 18 | 17 | 70 | | |
| 74 | 303 | 33 | 17 | 19 | 6 | 1 | 14 | 8 | 12 | 9 | 18 | 20 | 11 | 13 | 15 | 16 | 5 | 4 | 7 | 2 | 10 | 3 | 52 | | |
| 75 | 208 | 298 | 6 | 5 | 10 | 1 | 18 | 16 | 3 | 9 | 12 | 19 | 13 | 15 | 2 | 14 | 11 | 17 | 4 | 7 | 20 | 8 | 60 | | |
| 76 | 115 | 205 | 12 | 11 | 7 | 3 | 10 | 18 | 1 | 19 | 13 | 20 | 15 | 4 | 9 | 14 | 17 | 8 | 16 | 6 | 5 | 2 | 9 | | |

HOW TO USE THIS TABLE: The last two digits of y r sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, continue across and down from previous selection.

| Seeds 1 to 50 | Random Bearing | Random Bearing +90 | Randomized numbers 1 - 20 (left to right) | | | | | | | | | | | | | | Randomized numbers from 1 to 100 (top to bottom) | | | | | | ↓ |
|---------------|----------------|--------------------|--|----|----|----|----|----|----|----|----|----|----|----|----|----|--|----|----|----|----|----|-----|
| 77 | 143 | 233 | 1 | 7 | 18 | 8 | 2 | 11 | 19 | 5 | 14 | 12 | 13 | 9 | 10 | 15 | 16 | 17 | 4 | 3 | 20 | 6 | 43 |
| 78 | 37 | 127 | 15 | 11 | 1 | 8 | 10 | 20 | 9 | 14 | 18 | 17 | 5 | 6 | 4 | 13 | 2 | 16 | 12 | 7 | 19 | 3 | 5 |
| 79 | 250 | 340 | 18 | 12 | 4 | 15 | 16 | 8 | 14 | 19 | 13 | 2 | 5 | 3 | 11 | 10 | 1 | 9 | 17 | 20 | 6 | 7 | 3 |
| 80 | 356 | 86 | 10 | 15 | 8 | 19 | 14 | 17 | 4 | 16 | 13 | 9 | 18 | 1 | 11 | 2 | 7 | 6 | 3 | 5 | 20 | 12 | 64 |
| 81 | 326 | 56 | 12 | 8 | 10 | 15 | 19 | 1 | 20 | 13 | 14 | 18 | 16 | 7 | 2 | 6 | 5 | 9 | 17 | 11 | 4 | 3 | 15 |
| 82 | 162 | 252 | 2 | 4 | 12 | 17 | 3 | 10 | 1 | 15 | 5 | 18 | 6 | 8 | 19 | 16 | 20 | 11 | 13 | 9 | 14 | 7 | 19 |
| 83 | 352 | 82 | 7 | 17 | 8 | 2 | 1 | 16 | 3 | 20 | 15 | 18 | 14 | 6 | 12 | 9 | 10 | 4 | 19 | 11 | 13 | 5 | 22 |
| 84 | 266 | 356 | 6 | 15 | 12 | 17 | 7 | 16 | 8 | 19 | 13 | 4 | 10 | 18 | 14 | 11 | 5 | 1 | 2 | 20 | 3 | 9 | 84 |
| 85 | 81 | 171 | 15 | 14 | 19 | 1 | 4 | 17 | 10 | 20 | 7 | 11 | 13 | 8 | 5 | 18 | 3 | 12 | 9 | 6 | 2 | 16 | 95 |
| 86 | 235 | 325 | 9 | 5 | 12 | 19 | 3 | 16 | 14 | 15 | 2 | 20 | 10 | 1 | 7 | 6 | 17 | 18 | 13 | 8 | 11 | 4 | 4 |
| 87 | 205 | 295 | 2 | 1 | 12 | 10 | 19 | 13 | 16 | 17 | 6 | 18 | 11 | 3 | 14 | 8 | 5 | 15 | 7 | 9 | 4 | 20 | 17 |
| 88 | 335 | 65 | 5 | 19 | 2 | 14 | 8 | 6 | 13 | 3 | 15 | 12 | 16 | 18 | 4 | 9 | 11 | 17 | 1 | 20 | 10 | 7 | 21 |
| 89 | 56 | 146 | 6 | 11 | 3 | 12 | 1 | 4 | 5 | 18 | 20 | 14 | 13 | 7 | 17 | 16 | 10 | 15 | 8 | 2 | 19 | 9 | 65 |
| 90 | 308 | 38 | 13 | 19 | 7 | 18 | 10 | 1 | 4 | 11 | 17 | 12 | 9 | 3 | 5 | 16 | 15 | 8 | 2 | 14 | 20 | 6 | 54 |
| 91 | 76 | 166 | 14 | 11 | 3 | 1 | 15 | 12 | 18 | 10 | 6 | 9 | 13 | 5 | 16 | 19 | 2 | 17 | 20 | 8 | 7 | 4 | 13 |
| 92 | 36 | 126 | 13 | 15 | 14 | 19 | 10 | 12 | 1 | 8 | 11 | 4 | 5 | 17 | 18 | 2 | 20 | 9 | 7 | 3 | 16 | 6 | 62 |
| 93 | 227 | 317 | 12 | 2 | 19 | 11 | 14 | 10 | 16 | 9 | 15 | 3 | 20 | 17 | 18 | 1 | 6 | 7 | 5 | 4 | 13 | 8 | 25 |
| 94 | 342 | 72 | 20 | 4 | 19 | 11 | 6 | 8 | 9 | 10 | 15 | 16 | 5 | 13 | 7 | 12 | 2 | 14 | 17 | 1 | 18 | 3 | 35 |
| 95 | 16 | 106 | 19 | 1 | 13 | 9 | 15 | 14 | 5 | 11 | 10 | 16 | 18 | 6 | 17 | 3 | 2 | 20 | 8 | 7 | 12 | 4 | 51 |
| 96 | 204 | 294 | 13 | 9 | 5 | 7 | 1 | 10 | 17 | 14 | 11 | 8 | 20 | 15 | 18 | 4 | 12 | 16 | 19 | 2 | 3 | 6 | 24 |
| 97 | 290 | 20 | 19 | 5 | 18 | 8 | 2 | 9 | 3 | 14 | 10 | 4 | 7 | 6 | 1 | 13 | 11 | 15 | 17 | 20 | 12 | 16 | 71 |
| 98 | 239 | 329 | 11 | 12 | 17 | 13 | 10 | 1 | 14 | 20 | 15 | 6 | 2 | 19 | 8 | 16 | 4 | 9 | 3 | 7 | 18 | 5 | 100 |
| 99 | 5 | 95 | 10 | 8 | 15 | 1 | 16 | 2 | 12 | 9 | 14 | 5 | 3 | 13 | 11 | 17 | 18 | 4 | 7 | 20 | 19 | 6 | 44 |
| 100 | 181 | 271 | 1 | 12 | 8 | 14 | 3 | 10 | 6 | 11 | 19 | 20 | 7 | 16 | 2 | 9 | 15 | 4 | 5 | 13 | 18 | 17 | 90 |

HOW TO USE THIS TABLE: The last two digits of y r sample number is the seed number used to locate the random bearings for the transects and 20 randomized numbers for random and enhanced trees. If more than 20 numbers are required, proceed down the column on the far right from the row your seed number is located on. If more than 1 random number is required, continue across and down from previous selection.