DEPARTMENT OF NATURAL RESOURCES

DNR Resource Assessment
Forest Inventory Program Glossary

Terms and Acronyms

3DEP:
3D Elevation Program

3DGeo:
3D Geomatics Committee

4Trees:
Multi-module system designed to modernize and integrate the technologies within Division of Forestry for the purpose of increasing efficiency, timeliness, and accuracy of data collection, data management, and forest management. 4Trees: Minnesota DNR (state.mn.us)

Above-ground biomass (AGB):
The oven-dry biomass, in pounds, in the aboveground portion, excluding foliage, of live trees >= 5.0 inch DBH. This is a per tree value and must be multiplied by an adjustment factor to obtain per acre information.

Above-ground carbon (AGC):
The carbon, in pounds, in the aboveground portion, excluding foliage of live trees >= 5.0 inch DBH. This is a per tree value and must be multiplied by an adjustment factor to obtain per acre information. Carbon is assumed to be one-half the value of above-ground biomass.

Aircraft-Based Augmentation System (ABAS):
Method of augmentation to augment the GNSS information based on information available on board to enhance the performance (i.e. accuracy, integrity, continuity, availability) of the core-satellite constellations.

AMA:
Aquatic Management Area

ARbyFR:
All returns above 3m *100/ total first returns (penetration metric).

Aspect:
Compass direction or azimuth that a terrain surface faces, measured in degrees 0-360° where 0 is north-facing, 90 is east-facing, 180 is south-facing, 270 is west-facing. Lidar derived Aspect is a color visualization of the compass direction for slope.

ASPRS:
American Society for Photogrammetry and Remote Sensing

Assisted GNSS (A-GPS or aGPS):
Category of processes where some of the data transmitted from satellites (such as almanac and ephemerides) is instead retrieved from a server via internet over cellular data networks, allowing for faster start-up when determining position.

AwL:
Area with Limitation, a specific type of management area to control motorized vehicle use

Azimuth:
Horizontal angle from the cardinal direction North, ranging from 0 to 360°.

Bare Earth:
Digital elevation data of the terrain free from vegetation, buildings, and other man-made structures. Elevations of the ground.

Basal Area Weighted Height (BAWHT):
Also called Lorey's height. Plot-level average canopy height (in ft) that is obtained by multiplying the total height and basal area of individual sample trees, and then dividing the sum of the products by the total plot-level basal area.

Basal Area (BA):
It is the cross-sectional area of a tree stem measured at breast height (4.5 feet above the ground) and expressed in square feet. Also see SBA below.

BeiDou:
Satellite network system (or GNSS) owned and operated by China.

Breakline:
A linear feature that describes a change in the smoothness or continuity of a surface. The two most common forms of breaklines are Soft Breakline and Hard Breakline.

CBD:
Canopy Bulk Density (fire fuels metric). Canopy Bulk Density is defined as the mass per unit volume of canopy biomass that would burn in a crown fire (primarily foliage and twigs).

CBH:
Canopy Base Height describes the average height from the ground to a forest stand's canopy bottom. Specifically, it is the lowest height in a stand at which there is enough forest canopy fuel to propagate fire vertically into the canopy.

CFM:
Cooperative Forest Management

CFW:
Canopy Fuel Weight (fire fuels metric). Canopy Fuel Weight represents fuel load in foliage and fine branch-wood and is determined using equations dependent on tree species, DBH, crown ratio, and crown class. Crown weight equations are available for western USA to estimate total dry weight of live and dead material for each tree crown.

CHM:
Canopy Height Model. Represents the height above ground of the canopy surface. The tools for CHM in lidar processing software (e.g., FUSION) assigns the elevation of the highest return within each grid cell to the grid cell center. The tools have ability to smooth the surface using a median or mean filter together with an option of preserving local maxima to adhere to the tops of trees. The CHM is derived by subtracting ground elevation from the top return elevations.

Compound Topographic Index (CTI):
Steady state wetness index, calculated as a function of slope and upstream contributing area per unit width orthogonal to the flow direction.

Continuously Operating Reference Station (CORS):
A base station that operates continuously and typically in a network of base stations, with the correction information available on-demand over the internet, via a live feed for real-time correction or as an archive for post-processing.

Contour:
Lines that connect locations of equal elevation generated with specified intervals for smoothing to create interpretable elevations as lines on the landscape.

Cords Vol:
This layer was derived based on the gross cubic feet per acre volume raster. The gross cubic feet per acre volume was divided by 79 to convert the unit to cords per acre.

Cover3mAll:
Proportion of all returns above 3-m from the ground. Sometimes titled as "Cover_ab3m".

Cover3mInst:
Proportion of first returns above 3-m from the ground.

CoverMean1st:
Proportion of first returns above the mean.

CoverMeanAll:
Proportion of all returns above the mean.

CoverMode1st:
Proportion of first returns above the mode.

CoverModeAll:
Proportion of all returns above the mode.

Cover type:
Each pixel represents a (dominant) cover type belonging to one of the 13 forest cover type combination classes (below). The modeling of cover types required sample training data from PBI, FIA and FIM surveys on the ground and co-located lidar and other optical predictors. Cover type classes represented in 4Trees separate classes further than model created cover types. Refer to 4Trees Inventory Field Manual for more information on cover types used in 4Trees.

Model Cover Type Value	Model Cover Type Name	4Trees Cover Type Code	4Trees Cover Type	Comparison Notes
1	Lowland Hardwood/Ash	1,6,9,14,15	Ash, Willow, Lowland Hardwoods, Balm of Gilead, Cottonwood	*May include upland hardwood, primarily in upland-lowland transition areas*
12	Aspen/Birch	12,13,14,17, 78	Aspen, Birch, Balm of Gilead, Hybrid Poplar, Offsite Aspen	
20	Upland Mixed Hardwood	20,25,40	Northern Hardwood, Walnut, Central Hardwood	*May include oak and aspen/birch, primarily in mixed stand conditions*
30	Oak	30,79	*Oak, Offsite Oak*	*May include upland hardwood and aspen/birch, primarily in mixed stand conditions*
51	White Pine	51	White Pine	*General mixing of upland pine is expected.*
52	Norway Pine	52,54,55	Norway Pine, Scotch Pine, Ponderosa Pine	*General mixing of upland pine is expected.*
53	Jack Pine	53	Jack Pine	*General mixing of upland pine is expected.*
63	Upland Spruce-Fir	61,62,64,74	White Spruce, Balsam Fir, Norway Spruce, Black Spruce-Upland	*Jack Pine may often be represented here. Plantation sites may cause mixing with pine.*
71	Black Spruce	71,74,75	Black Spruce-Lowland, Black Spruce-Upland, Stagnant Spruce	*May include upland spruce, primarily in upland-lowland transition areas. May include tamarack*
72	Tamarack	72,70,76	Tamarack, Upland Larch, Stagnant Tamarack	*May include black spruce.*
73	Cedar	73,77,81	White Cedar, Stagnant Cedar, Red Cedar	
96	Water	96,97	Permanent Water, Nonpermanent Water	
99	Non-Forest	83,84,85,86, 87,88,90,91, 92,93,94,95, 98,99	Lowland Grass, Upland Grass, Lowland Brush, Upland Brush, Duff, Moss, Unknown, Agricultural, Industrial Developed, Recreation Developed, Roads, Rock Outcrop, Marsh, Muskeg	*All "non-forest" cover types are included. Recent disturbance on forest sites may result in non-forest classification. Consider disturbance history and monitoring information.*

CRR:

Canopy relief ratio ((mean - min) / (max – min))

CRSL:

Camp Ripley Sentinel Landscape

CSA:

Cooperative Stand Assessment

CTI:
Compound Topographic Index

CV:
Coefficient of variation. Provides information about the overall variability of structural features (BAA, QMD, Volume) being measured. It is calculated as the standard deviation divided by the mean and it is expressed as a percent.

Datum:
An associated model of the shape of the Earth (reference ellipsoid) to define a geographic coordinate system. Horizontal datums are used for describing a point on the Earth's surface, in latitude and longitude or another coordinate system. Vertical datums are used to measure elevations or depths.

DBH:
Diameter at breast height (4.5’ above ground)

DEM:
Digital Elevation Model, digital representation of elevation above sea level of the bare ground surface of the Earth (excluding trees, buildings, and any other surface objects).

Differential GNSS (DGNSS, also DGPS):
using a stationary base station receiver to measure error, generate corrections, and apply those corrections to a rover receiver.

DNR:
Department of Natural Resources

DSM:
Digital Surface Model, digital representation of elevation above ground (DEM) of natural built features on the Earth’s surface (it is not a normalized height surface but sum of DEM and CHM).

DTM:
Digital Terrain Model. As defined by the USGS, a vector dataset composed of 3D breaklines and irregularly spaced 3D mass points that characterize the shape of the bare-earth terrain. A DTM is not a surface model and its component elements are discrete and not continuous; a TIN or DEM surface must be derived from the DTM. Surfaces derived from DTMs can represent distinctive terrain features much better than those generated solely from gridded elevation measurements.

ECS:
Ecological Classification System

ElevAAD:
Average absolute deviation from mean of all returns for the cell.

ElevAv:
Mean of elevation distributions of all returns per grid cell.

ElevCM:
Cubic mean of elevation distributions of all returns per grid cell.

ElevCV:
Coefficient of variation of elevation distributions of all returns per grid cell.

EleveLCV:
L-moment coefficient of variation of all returns above for the grid cell.

ElevIQ:
Interquartile range of elevation distributions of all returns for the cell.

ElevL1:
First L-moment of elevations of all returns for the cell.

ElevL2:
Second L-moment of elevations of all returns for the cell.

ElevL3:
Third L-moment of elevations of all returns for the cell.

ElevL4:
Fourth L-moment of elevations of all returns for the cells.

ElevLkurt:
L-moment kurtosis of all returns for the grid cell.

ElevLskew:
L-moment skewness of all returns for the grid cell.

ElevMADmed:
Median of the absolute deviations from the overall median of elevations per cell.

ElevMADmode:
Mode of the absolute deviations from the overall mode of elevations per cell.

ElevMax:
Maximum of elevation distributions of all returns per grid cell.

ElevMode:
Mode of elevation distributions of all returns per grid cell.

ElevP01:
1st percentile of elevation distributions of all returns for the cell. In other words, 1% of all returns for a given pixel have elevations below the pixel value.

ElevP10:
10th percentile of elevation distributions of all returns for the cell. In other words, 10% of all returns for a given pixel have elevations below the pixel value.

ElevP50:
50th percentile of elevation distributions of all returns for the cell. In other words, 50% of all returns for a given pixel have elevations below the pixel value. Note that 50^{th} percentile is also known as median (ElevMedian).

ElevP90:
90th percentile of elevation distributions of all returns for the cell. In other words, 90% of all returns for a given pixel have elevations below the pixel value.

ElevP95:
95th percentile of elevation distributions of all returns for the cell. In other words, 95% of all returns for a given pixel have elevations below the pixel value.

ElevQM:
Quadratic mean of elevation distributions of all returns per grid cell.

ElevSD:
Standard deviation of elevation distributions of all returns per grid cell.

ElevVar:
Variance of elevation distributions of all returns per grid cell.

ENRTF:
Environment and Natural Resources Trust Fund

European Geostationary Navigation Overlay System (EGNOS):
the first pan-European Satellite navigation system, augmenting the US GPS satellite navigation system, operated for the European Union.

FIA:
Forest Inventory Analysis – forest inventory program of the USDA Forest Service

FIM:
Forest Inventory Module, an older forest inventory system for the DNR

FIPS:
Federal Information Processing Standards, e.g., numeric codes for counties

Forest Inventory Models:
Spatial inventory models for different forest attributes based on integration of different sources of remotely sensed data (lidar point cloud, satellite imagery, aerial photos) and ground sample plot data (PBI, FIA, CSA).

FUSION:
FUSION, a suite of software developed by USFS Pacific Northwest Research Station, is designed for visualizing and analyzing airborne lidar data. See **Additional Resources** Section for more information.

FY:
Fiscal Year

Galileo:
Satellite network system (or GNSS) owned and operated by the European Union.

GDRS:
Geographic Data Resource Site

GIS:
Geographic Information Systems

Global Differential GPS (GDGPS):
A high accuracy GPS augmentation system developed by the NASA Jet Propulsion Laboratory.

Global Navigation Satellite System (GLONASS):
Satellite network system or GNSS) owned and operated by Russia.

Global Navigation Satellite System (GNSS):
Any satellite constellation (including GPS) that provides positioning, navigation, and timing services on a global scale.

Global Positioning System (GPS):
Satellite network system (or GNSS) owned and operated by USA.

GMP:
Guideline Monitoring Program

GPS:
Global Positioning System

Grid Metrics:
Lidar-derived statistical metrics based on elevation value of returns falling within each grid cell.

Gross volume:
This is the total volume of wood (without considering cull or decay) in the central stem of measured trees of 5.0-inch or larger DBH, from a 1-foot stump to a minimum 4-inch top diameter, or to where the central stem breaks into limbs all of which are <4.0 inches in diameter. This is a per tree value and must be multiplied by an adjustment factor to obtain per acre estimate.

Ground-Based Augmentation System (GBAS):
Augmentation of the existing GPS used in U.S. airspace by providing corrections to aircraft in the vicinity of an airport to improve the accuracy of and provide integrity for aircrafts' GPS data. Satellite Navigation - GBAS - How It Works | Federal Aviation Administration (faa.gov).

Hillshade:
3D representation of the terrain's surface with a lighting effect modeled from the angle of the sun for emphasizing the relief on the landscape.

HPI:
Hydrographic Position Index

Hydrographic Position Index (HPI):
Digital representation of that accentuates the location of water conveyance landforms on Earth surface. Hydrographic Position Index (HPI) (mn.gov)

IntIQ:
Interquartile range of intensity values per cell.

IntMax:
Maximum of intensity values per cell.

IntMean:
Mean of intensity values per cell.

IntSD:
Standard deviation of intensity values per cell.

LAA:
Lidar acquisition area

LAB:
Lidar Acquisition Block

LAS:
A public file format for the interchange of 3D point cloud data between data users. The file extension is ".las".

LCCMR:
Legislative-Citizen Commission on Minnesota Resources

Lidar:
Light Detection and Ranging

Local-Area Augmentation System (LAAS):
Old term for GBAS specific to USA.

LRS:
Land Records System

LSR:
Landscape Scale Restoration, a USFS grant program

Max height:
Represents modelled maximum height of trees (in ft) in a stand. The lidar point cloud extracted for each of the sample plots were processed to obtain numerous predictor metrics that were regressed against the plot-level max height observations. The regression model was then extended spatially over the entire area of interest using the most significant lidar grid metrics at 20-m spatial resolution.

MB:
Mobile Builder

MFA:
Minnesota Forestry Association

MFI:
Minnesota Forest Industries

MFRC:
Minnesota Forest Resources Council

MFRP:
Minnesota Forest Resources Partnership

MnCORS:
Continuously Operating Reference Station (CORS), operated by Minnesota Department of Transportation (MnDOT)

MnGeo:
Minnesota Geospatial Information Office

NAD27:
North American Datum of 1927

NAD83:
North American Datum of 1983

NAIP:
National Agriculture Imagery Program

nDSM:
Normalized Digital Surface Model (DSM minus DEM), digital representation of the height of natural and built features above Earth's bare ground. A nDSM is derived by subtracting DEM values from the DSM values. This derived product is akin to the canopy height model, where all CHMs are technically nDSMs, but nDSMs do not represent the forest canopy alone.

Networked Transport of RTCM VIA Internet Protocol (NTRIP):
Protocol for streaming DGPS corrections over the Internet for RTK positioning.

NRRI:
Natural Resources Research Institute, affiliated with the University of Minnesota-Duluth

OOB:

Out of bag

Plot Based Inventory (PBI):
1/10th acre (37.2' radius) fixed radius forest inventory plots

PFM:
Private Forest Management

Post-Processing (PP):
Taking a recorded position and any necessary associated data and applying corrections after data collection in the field.

Precise Point Positioning (PPP):
A GNSS positioning method that calculates very precise positions, with errors as small as a few centimeters under good conditions. Precise Point Positioning - Navipedia (esa.int).

QA/QC:
Quality Assurance/Quality Control

QMD:
Quadratic mean diameter (in inch) is the diameter of the tree of average per tree basal area computed from diameter at breast height (DBH).

Quasi-Zenith Satellite System (QZSS):
Satellite system (or GNSS) operated by Japan.

Radio Technical Commission for Maritime Services (RTCM):
A non-profit international standards organization.

RAP:
Resource Assessment Program (aka, RA: Resource Assessment)

Real-Time Kinematic [positioning] (RTK):
Processes for correcting errors in GNSS signals, requires a real or virtual base station and some method of data transfer.

RFP:
Request for proposals

RFO:
Request for order

RGMA:
Ruffed Grouse Management Area

RMSE:
Root mean square error

RS:
Remote Sensing, Remotely Sensed

SAF:
Society of American Foresters

Satellite Navigation (Satnav):
A network of satellites that transmit radio signals from medium Earth orbit and include GPS, GLONASS, Galileo, and BeiDou. On a global scale, this is known as Global Navigation Satellite System (GNSS). Satellite Navigation–- GPS–- How It Works | Federal Aviation Administration (faa.gov).

SBA:
Represents stand basal area in square feet per acre for all live trees of five inches or larger dbh.

Satellite-Based Augmentation System (SBAS):
Augmentation system using geostationary satellites for augmenting primary GNSS constellations. The SBAS provides integrity assurance and increases accuracy. SBAS Fundamentals - Navipedia (esa.int).

SE:
Standard error. A statistical measurement used to estimate variability within a population.

SFRMP:
Section Forest Resource Management Plans

Site Index (SI):
Represents the estimated total height (in feet) that dominant and co-dominant trees of a target species will attain at a base age of 50 years in a fully-stocked, even-aged stand of the same species in a competition free environment.

SLA:
Service Level Agreement

Slope:
Slope of terrain, representing the steepness, change in elevation or degree of inclination over a space, measured in units of degrees or percent. Lidar derived slope is a color visualization of the maximum rate of change in value from a cell to neighboring cells.

SNA:
Scientific and Natural Area

Solar Radiation Index (SRI):
Combines information about the aspect, slope, and latitude into a single index that describes the amount of solar radiation theoretically striking an arbitrarily oriented surface during the hour surrounding noon on the equinox.

SPL:
Single photon lidar

SRI:
Solar Radiation Index

SRM:
Silviculture and Roads Module

Stem density:
A stand attribute representing tree count per acre (trees per acre)

Strata1:
Stratum-1 Proportion of all returns in the horizontal stratum from ground up to 1.37m.

Strata2:
Stratum-2 Proportion of all returns in the horizontal stratum from 1.37 to 5m above ground.

Strata3:
Stratum-3 Proportion of all returns in the horizontal stratum from 5 to 10m above ground.

Strata4:
Stratum-4 Proportion of all returns in the horizontal stratum from 10 to 15m above ground.

Strata5:
Stratum-5 Proportion of all returns in the horizontal stratum from 15 to 20m above ground.

Strata6:
Stratum-6 Proportion of all returns in the top most stratum above 20m from the ground.

TIN:
Triangular Irregular Network

TIS:
Terrestrial Invasive Species

TLS:
Terrestrial laser scanner

TNC:
The Nature Conservancy

TNM:
The National Map. Collaborative effort hosted by the U.S. Geological Survey to improve and deliver topographic information.

Topographic Position Index (TPI):
Digital classification of the terrain where the elevation of each point is evaluated relative to the elevation of the surrounding points. The classification results in positive values for points higher than its surroundings and negative values for points lower than its surroundings.

TPA:
Represents live stem count or trees on a per acre (TPA) basis in a stand.

Triangulated Irregular Network (TIN):
Elevation surface that represents height values across an extent forming a surface model. A TIN is constructed by connecting a set of vertices through a series of non-overlapping edges, forming a network of triangles.

TSM:
Timber Sale Module

U&M:
Utilization and Marketing

UAS:
Unoccupied Aerial System

UAV:
Unoccupied Aerial Vehicle

UMN:
University of Minnesota

USDA:
US Department of Agriculture

USFS:
US Forest Service

USGS:
US Geological Survey

UTM:
Universal Transverse Mercator

VBAR:
Volume to Basal Area Ratio

Virtual Reference Station (VRS) or Virtual Reference Network (VRN):
A networked service that provides data for RTK needs, simulating a base station by interpolating data from real base stations.

VR:
Variable Radius

Wide Area Augmentation System (WAAS):
High accuracy satellite system developed for civil aviation, operated by USA. Satellite Navigation - Wide Area Augmentation System (WAAS) | Federal Aviation Administration (faa.gov).

WMA:
Wildlife Management Area

WMS:
Web Mapping Services

Additional Resources

Forest Inventory Viewer:
Interactive online map application that provides interactive, map based access to a variety of DNR Forestry geographic datasets including stand-based, forest inventory data for state-administered lands with access to detailed information for each inventoried stand. ForestView (state.mn.us).

FUSION:
A software developed by the US Forest Service and the University of Washington to explore and analyze lidar data. The analysis and visualization system consists of two main programs, FUSION and LDV (LIDAR data viewer), and a collection of task-specific command line programs. FUSION software manual | (forsys.cfr.washington.edu).

Landview:
Interactive online mapping tool allowing for creation of customized maps based on DNR data layers including public lands, water bodies, roads, aerial photos, etc. Landview was developed and managed by

MN DNR using the University of Minnesota MapServer software. Landview | Minnesota DNR (state.mn.us).

Minnesota Geospatial Commons:
The Commons is a collaborative space for users and publishers of Minnesota's geospatial resources. See: Minnesota Geospatial Commons.

Minnesota Natural Resource Atlas:
Interactive online map provides a basic set of GIS tools for viewing, searching, and manipulating natural resource related data. The application is developed and managed by the Natural Resources Research Institute and the University of MN Duluth. Minnesota Natural Resource Atlas (mnatlas.org).

MnTOPO:
Interactive web application for viewing, printing and downloading high-resolution elevation data for the State of Minnesota created from the initial lidar data collection, MnTOPO (state.mn.us).