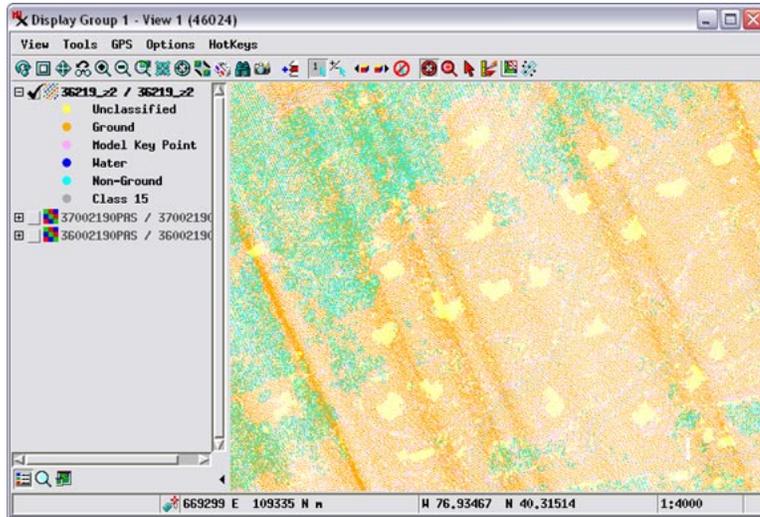


View LAS Point Cloud as Surface

TNTmips Pro allows you to display a LIDAR point cloud in the standard LAS file format as a virtual surface. The virtual surface can be colored by elevation, shown in grayscale shaded-relief, or in a combination of shading and elevation color. The virtual surface is constructed on-the-fly from a subset of the points visible in the view, so displaying the surface is **as fast as** displaying the points themselves. You can select the points to use to create this surface based on return type and LIDAR point class (such as ground, building, and so on). You can view the virtual surface with or without overlaid LIDAR points by adjusting a minimum point spacing threshold that automatically turns the point display off at zoom levels where the points are so closely spaced that they would obscure the terrain. Controls for constructing and visualizing the virtual terrain surface are on the Terrain tabbed panel of the Lidar Layer Controls window, which is illustrated at the bottom right.

An overview of all LAS LIDAR display options is presented in the Technical Guide entitled *LIDAR: LAS Point Cloud Display Options*. You can display LIDAR points directly, subsetting and styling them based on their LIDAR characteristics, as described in more detail in the TechGuides *LIDAR: Select Points by Class, Return Type, Intensity*, and *LIDAR: Style Points by Class, Elevation, Intensity*.



View of a small portion of a LIDAR point cloud (total over 5.3 million points) that will be used here to illustrate virtual surface display. The view is about 550 meters in width, with nominal ground spacing of the LIDAR points about 1.5 meters. The area shown is a steep hillside sloping downward from upper left to lower right of the view. The natural color orthoimage of the same area at right shows residential roads and homesites with forest in the northwestern (higher) portion (the LIDAR points and orthoimage were both acquired under leaf-off conditions). The LIDAR points were partially classified by the vendor using automated procedures, with class colors shown in the legend in the View illustration at left. Points in the Ground (orange) and Model Key Point (pink) classes are single-return points interpreted to be on the bare earth surface. Non-Ground points (cyan) are the first or intermediate of multiple returns, interpreted as likely vegetation points. The Unclassified points (yellow) are interpreted to include manmade structures and some vegetation. Visual comparison of the classified point cloud and the orthoimage confirms that this classification is generally accurate.

Relief Shaded Surface

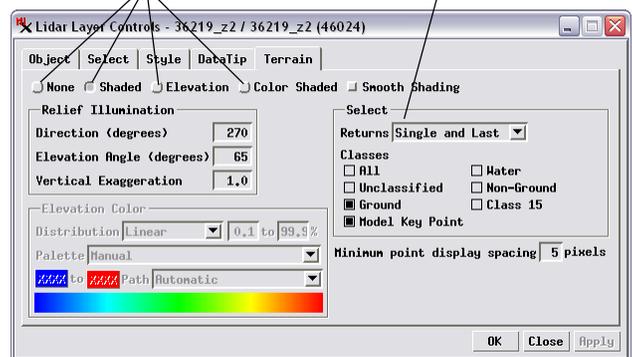
The Shaded option for virtual surface display presents a grayscale shaded-relief view. The Relief Illumination panel provides standard controls for the shading: Direction and Elevation Angle of the virtual illumination source and Vertical Exaggeration of the surface.



Turning on the Smooth Shading toggle in the Terrain tabbed panel applies a smoothing function to (over)

Radio buttons on the Terrain tabbed panel for choosing the terrain display type (or none).

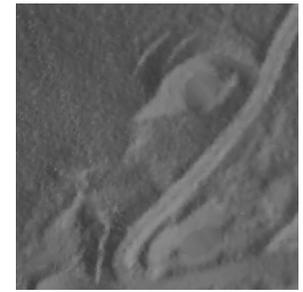
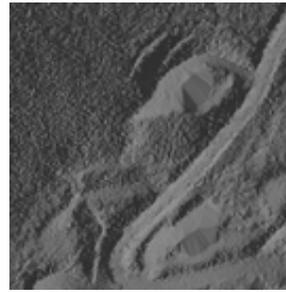
The Select panel includes controls for choosing the subset of points to use to construct the virtual terrain.



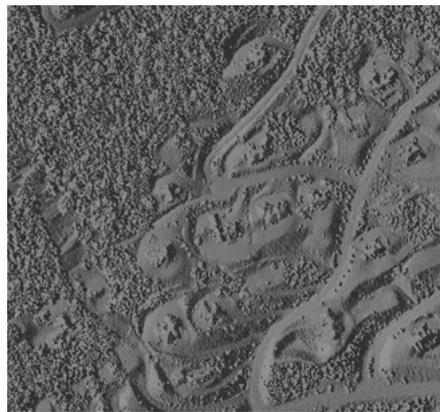
Relief-shaded virtual terrain (above left) constructed from the LIDAR points shown top left using bare-earth points and Single and Last returns (set using the Select controls as shown in the illustration above right). The shaded terrain shows that homesites have been leveled by cutting into the hillside on the uphill side and building embankments on the downhill side.

the virtual surface before the shaded view is created. Smoothing is designed to suppress small irregularities in the surface that represent small objects or that result from artifacts (noise) in the elevations measured by the LIDAR sensor. A sample comparison of smoothed and unsmoothed virtual surfaces is illustrated to the right.

For all terrain display options you can use the controls on the Select panel (illustrated on the reverse and below) to choose the subset of points used to construct the virtual surface. You can choose any combination of classes to use, or All. On the Returns menu you can choose between *Single and Last* (single returns and last of multiple returns) and *Single and First* (single returns and first of multiples). When you are viewing an unclassified point



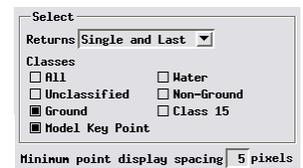
Detail of shaded virtual terrain display without smoothing (above left) and with smoothing (above right).



Shaded virtual surfaces for the western portion of the sample area using all LIDAR point classes, including buildings and vegetation. The surface on the left was constructed using the Single and Last option from the Returns menu. In the forested area, the last of multiple returns reaches deeper into the tree canopy and in places reaches the ground. The surface on the right was constructed using the Single and First return option, and thus models more of the tree canopy in the forested area.

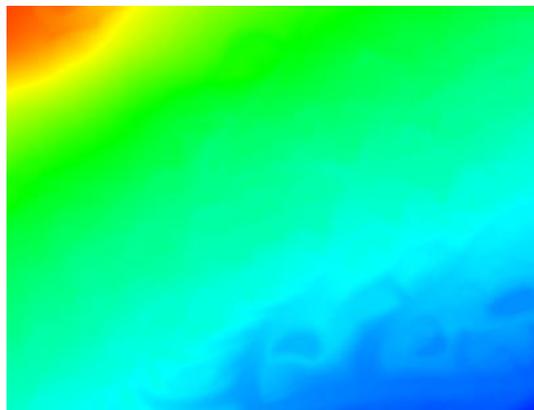
cloud, the Single and Last return option provides a virtual terrain that more closely models a bare earth surface. The illustrations to the left show shaded virtual surfaces constructed using all LIDAR point classes but with different choices for return type.

The *Minimum point display spacing* field sets the minimum allowed spacing (in screen pixels)



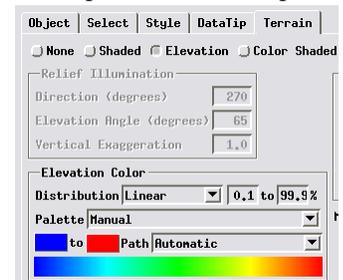
between LIDAR points to allow the points to be shown overlaid on the virtual surface. Point display is automatically turned off at zoom levels at which the points would be more closely spaced than this value.

Surface Colored by Elevation



Virtual surface for the sample area constructed using only bare earth points and displayed using the Elevation terrain option with the color spread shown in the Elevation Color interface illustration to the right. The elevation colors highlight the general southeast slope of the bare earth surface.

The Elevation terrain option applies a color spread to the range of elevations in the virtual surface, as illustrated to the left. Turning on this option activates the Elevation Color controls, illustrated to the right. You select a predefined color spread using the Palette menu or choose Manual to design a custom spread. The Manual option provides color buttons to set the starting and ending colors for the spread and a Path menu for choosing a color path (such as RGB, HIS Clockwise, and others). You can use the Distribution menu to apply a mathematical redistribution to the elevation values in the surface before the color spread is applied. The Distribution options are Linear, Equalize, Normalize, and Logarithmic. The numeric fields to the right of the Distribution menu set percentage limits for the range of elevations to include in the spread, which you can use to eliminate spurious high and low elevation values from the spread range.



Color Shaded Surface

The Color Shaded terrain option combines a shaded relief display with a color spread by elevation to provide a synoptic view of the surface, as shown for the sample area in the illustration to the right. The Relief Illumination and Elevation Color controls are both active with this option and can be adjusted as described above. The surface can also be smoothed using the Smooth Shading option.

Virtual surface for the sample area constructed using only bare earth points and displayed using the Color Shaded terrain option.

