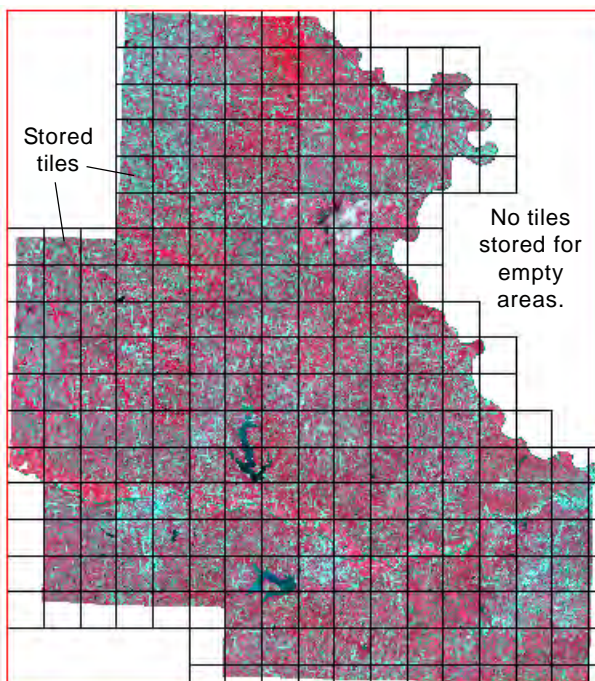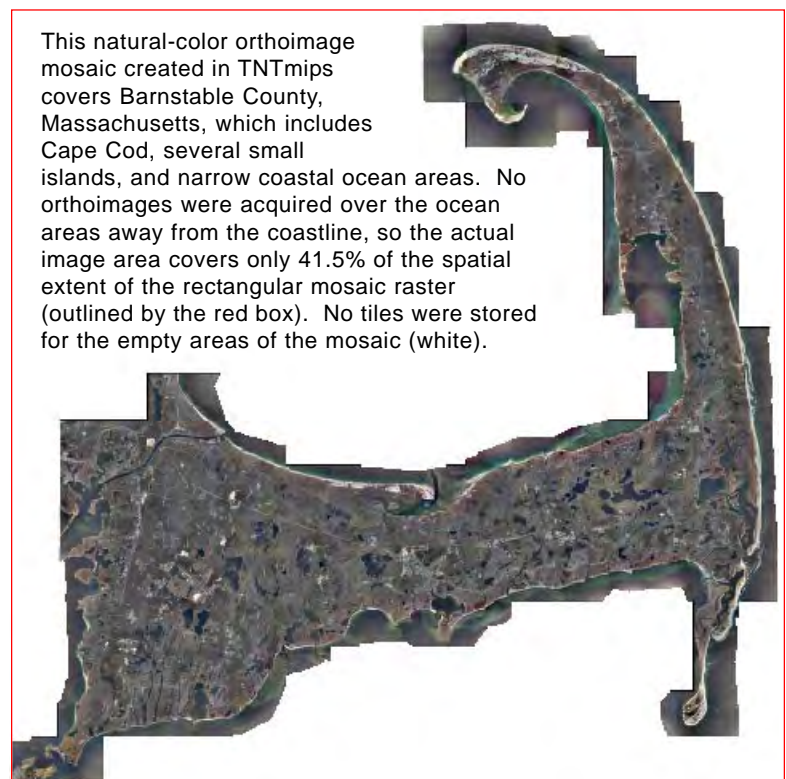# Empty Tiles Not Stored in Raster Objects

MicroImages has optimized the internal structure of spatial data objects in the TNT products to enable you to cover entire large project areas with single spatial objects that have high spatial detail. The boundaries of your project area may be irregular in shape because you don't have or don't need to show or process data outside of those limits. For large raster objects, this means that some boundaries of your real data values can be well inside the edge of the rectangular raster encompassing your project area, leaving large empty areas around the margins. These empty areas are indicated by a binary null mask or by a single raster value that has been assigned as the null value. Since these empty areas contain no useful data, the TNT products save on file space by not storing raster values for large portions of these empty areas.

The TNT products use an internal tiling scheme for storing a raster object in a Project File. Each raster object is subdivided into small, uniform, rectangular tiles, and the data values for the cells in each tile are stored together in the file for efficient display and processing. For raster objects with large null areas, many internal tiles may lie entirely within the null area and thus contain no useful data. Storage of a set of default cell values for these empty tiles would add significantly to the file size of the raster object. Although applying compression to the raster object mitigates this problem somewhat (empty internal tiles have a uniform cell value and thus can be highly compressed), the storage overhead for empty tiles can still be significant for large raster objects with complex boundaries. And there may be many instances in which using compression is not appropriate: you may need to preserve the original raster cell values to do further processing, or you may simply wish to avoid lossy compression artifacts in the image. The TNT products avoid this problem entirely, as all processes that create raster objects automatically detect tiles that are entirely null and omit these tiles from the file structure.

Stored tiles

No tiles stored for empty areas.

This Landsat color-infrared image of an irregularly-shaped area of several counties in northeast Kansas was mosaicked in TNTmips. The large red rectangle outlines the outer boundary of the raster objects, while the black rectangles represent the boundaries of the internal tiles stored in each raster object for this image. Note that no tiles are stored in these raster objects for areas that contain no real data values. Also note that partial tiles are automatically used at the east (right) and south (bottom) edges of the real image area.

This set of three relatively small 8-bit raster objects has an extent of 4183 columns by 4755 lines and a cell size of 30 meters. The size of the tiles set by the Mosaic process in these internal raster objects is 256 by 256 cells. If values were stored for all empty areas of these rasters, their uncompressed size including pyramid tiers would be 80 MB (4183 x 4755 x 3 raster objects = 60 MB plus ~30% more for the pyramid tiers). The actual uncompressed size of the 3 rasters and their pyramid tiers with no empty tiles stored is 67 MB.

This natural-color orthoimage mosaic created in TNTmips covers Barnstable County, Massachusetts, which includes Cape Cod, several small islands, and narrow coastal ocean areas. No orthoimages were acquired over the ocean areas away from the coastline, so the actual image area covers only 41.5% of the spatial extent of the rectangular mosaic raster (outlined by the red box). No tiles were stored for the empty areas of the mosaic (white).

This 24-bit composite raster object has a cell size of 0.5 m and an extent of 136,000 columns by 136,000 lines. The Mosaic process has set the tile size for this internal raster object at 512 by 512 cells. If cell values were stored for all of the empty areas of this raster, its raw uncompressed size would be 51.7 GB ($136,000^2$ cells x 3 bytes per cell); the addition of pyramid tiers and null mask would result in an aggregate size of 69.1 GB. The size of the actual uncompressed mosaic without empty tiles (including pyramid tiers and null mask) is 20.74 GB. Applying lossy JPEG2000 compression with a 20:1 compression ratio (to match that of the compressed input orthoimages) when using the TNT Mosaic process to create this raster object reduces the required storage to 2.4 GB (including pyramid tiers and null mask).