



MEMORANDUM

TO: Thom McCue

FROM: Rich Walter and Paul Cylinder, Jones & Stokes

DATE: June 29, 2004

RE: Update of Undeveloped Monterey Pine Forest Baseline Using 2002 Data

This memorandum provides a report of the results of a comparison of mapping based on data collected on Monterey pine forest by Jones & Stokes in 1994 and mapping of Monterey pine forest prepared by Monterey Pine Forest Watch (MPFW) in 2003.

1994 FOREST MAPPING METHODS

In 1994, Jones & Stokes ecologists conducted various studies and prepared two reports for the California Department of Fish and Game (DFG) (Jones & Stokes 1994a; 1994b). Included in these studies was an assessment of the extent of Monterey pine forest at Monterey. The results of that study were presented in the report “*Monterey pine forest ecological assessment: historical distribution, ecology, and current status of Monterey pine*” (Jones & Stokes 1994a).

Occurrences of Monterey pine were classified into various mapping categories:

- Monterey pine in urban areas, sparse cover (<20% canopy cover)
- Monterey pine in urban areas, dense cover (>20% canopy cover)
 - Urban development
 - Golf courses
 - Urban parks
- Monterey pine forest in suburban developments (lots <1 acre)
- Monterey pine forest in rural development (lots >1 acre)
- Monterey pine forest in undeveloped areas (natural understory)
 - Monterey pine dominates the canopy
 - Monterey pine mixed with Bishop pine
 - Monterey pine in riparian setting

Forested areas supporting a Monterey pine dominated canopy with the natural understory substantially intact were classified as “undeveloped Monterey pine forest.” Mapping of the forest by Jones & Stokes in 1994 was conducted by aerial photographic interpretation and limited field verification. Aerial photographs used were 9 x 9 inch format, 1:12,000 scale, unrectified, false color, infrared images taken on December 2, 1993. The 1994 mapping was conducted on 1:12,000 acetate topographic base maps (enlarged from 1:24,000 scale U.S. Geological Survey Quadrangles). Monterey pine forest identified from the aerial photographs was visually rectified and delineated on the topographic base map using identifiable common features such as roads, streams, and ridge crests. The nominal minimum mapping unit was 5 acres. Delineated boundaries of the forest and other land cover types were entered into a GIS database. The total extent of undeveloped Monterey pine forest identified in 1994 was 9,405 acres.

2003 MPFW MONTEREY PINE FOREST MAPPING

In 2003, MPFW produced a GIS database of undeveloped Monterey pine forest based on recent aerial photography. Aerial photographs used were large format, geo-rectified, false color, infrared images taken on May 8, 2002. Mapping of forest boundaries was apparently conducted directly on the images. According to MPFW: “This map was created by overlaying data developed by Jones & Stokes in 1994 over a very high-resolution (~1ft) infrared aerial photograph taken in 2002. The data was then modified to exclude only those areas of development that could clearly be seen on the recent aerial.” (Smith, pers. comm.) The total extent of Monterey pine forest delineated by MPFW using the 2002 imagery is approximately 8,300 acres.

METHODS FOR COMPARISON

Jones & Stokes compared and evaluated the differences between the 1994 Jones & Stokes forest mapping and the 2003 MPFW forest mapping to determine why differences existed between the two results and which of those differences were in fact due to changes in visually observable land use between 1993 and 2002, based on aerial imagery.

Jones & Stokes printed the 2002 image with the forest boundary line-work from both the 1994 Jones & Stokes and 2003 MPFW mapping efforts on the printed image in different colors. This printed image was inspected visually for discrepancies between the two data sets. Where discrepancies were found, we compared the 2002 image with the 1993 aerial photograph from the same location. We focused on identifying sites where new development had occurred between 1993 and 2002 that resulted in the removal of undeveloped Monterey pine forest. Our review was limited to the areas of discrepancy alone.

RESULTS OF COMPARISON

The great majority of differences between the 1994 Jones & Stokes and the 2003 MPFW mapping efforts result from differences in mapping materials and methods used by Jones & Stokes and MPFW and not due to new development. The differences in mapping results are

mostly explained by differences in:

- resolution and quality of the 1993 and 2002 images (for example, the 1993 photographs contain many shadows that prevent boundaries from being clearly visible)
- rectification between the visually rectified 1994 data set and the 2003 data set developed from a geo-rectified image (for example, many overlapping polygons were similar or nearly identical in shape but spatially off-set from each other, indicating that the same forest patch was mapped in both data sets but the mapped location was not the same)
- mapping methods used by Jones & Stokes versus MPFW (for example, many overlapping polygons varied in shape and size and this difference in photographic interpretation caused the difference in the forest extent)
- interpretation of development within which removal of understory vegetation is likely (for example, sites where some structures are present were interpreted by Jones & Stokes to support undeveloped Monterey pine forest while MPFW did not).

Where MPFW interpreted sites with structures as not supporting undeveloped Monterey pine forest, we compared the 1993 and 2002 imagery to determine if those same structures were present in 1993 and 2002. If the same structures were present, we determined that the difference between the 1994 and 2003 mapping efforts was due to differences in mapping methods and interpretation and not due to any real change in the extent of forest (i.e., did not represent new development removing pine forest during that period). Where we found new structures or large openings in the forest in the 2002 imagery that were not present in the 1993 images, we determined that forest removal had occurred during the period.

We found seven sites within areas of discrepancy between the 1994 Jones & Stokes mapping and the 2003 MPFW mapping at which forest removal appears to have resulted from new development between 1993 and 2002. The total extent of forest removal for these sites was 78.6 acres. This acreage estimate is our estimate of the amount of change in forest extent between 1993 and 2002 located within the areas of discrepancy that were examined. Table 1 provides a summary of the sites in which we identified changes in forest cover between the 1993 and 2002 images in the areas of discrepancy. The locations of these sites are provided in Figure 1.

**Table 1. Sites Identified With Development between 1993 and 2002 that Resulted
in Removal of Undeveloped Monterey Pine Forest**

Site number and name	Estimated Reduction in Extent (acres)
1. Tehama Development	15.3
2. Sombria Lane	17.0
3. Sombria Lane-Portola Road	9.9
4. Macomber	26.8
5. Quail Ridge	3.0
6. Corona Road	2.0
7. Mentone Drive	4.6
Total	78.6

In addition to identifying areas of new development, we also identified a site supporting a large extent of Monterey pine forest over suburban development that was mapped in 1994 as undeveloped Monterey pine forest. While other areas may have been mapped incorrectly, this specific polygon was large and we determined that it should be remapped. Based on the remapping, 37 acres were removed from the total extent of undeveloped Monterey pine forest estimated in 1994 ($9,405 - 37 = 9,368$ acres).

CONCLUSIONS

Based on the results of this analysis, the updated extent of undeveloped Monterey pine forest in 2002 is estimated at 9,289 acres, a reduction of approximately 79 acres from the 9,368 acres of forest that existed in 1994. Based on these estimates, the loss of undeveloped Monterey pine forest since 1993 has been about 1%.

LIMITATIONS

These conclusions are based solely on visual analysis of remotely sensed data within the areas of discrepancy between the 1994 Jones & Stokes mapping and the 2003 MPFW mapping. These conclusions are not based on any assessment of the quality of the remaining forest that may have been affected by pine pitch canker, bark beetles, sudden oak death, and other factors over the past 10 years. The resultant updated extent of undeveloped pine forest cover identified for 2002 is limited by the methodology used in the 1994 Jones & Stokes mapping and the methodology used for the comparison as described in this memorandum.

REFERENCES AND COMMUNICATIONS

Jones & Stokes Associates, Inc. 1994a. Final. *Monterey pine forest ecological assessment: historical distribution, ecology, and current status of Monterey pine*. September 12. (JSA94-083) Sacramento, CA. Prepared for The Nature Conservancy, Sacramento, CA, and the California Department of Fish and Game, Monterey, CA.

Jones & Stokes Associates, Inc. 1994b. Final. *The Monterey ecological staircase: the nature of vegetation and soils on different geomorphic surfaces of the Monterey Peninsula with an emphasis on Monterey pine forest*. September 12. (JSA94-083) Sacramento, CA. Prepared for the California Department of Fish and Game, Monterey, CA.

Smith, Linda. President, Monterey Pine Forest Watch. Letter to Thomas McCue, Monterey County Planning and Building Inspection Department, dated June 7, 2004.