



Date: February 8, 2013

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Project: Preparation of 85th and 95th Percentile Precipitation Maps

Subject: Task 2 – Memo to Explain Process for Developing 85th and 95th Percentile 24-hour Rainfall Depths

Tetra Tech previously developed a set of quality controlled hourly rainfall time series using all available data published by the National Climatic Data Center (NCDC) for the Central Coast region. Data from 44 Summary of Day (SOD) gages were compiled and processed. From past correspondence with NCDC staff and from previous experience processing these data for modeling purposes, it had been determined that the SOD gages provide more reliable daily rainfall totals than the gages that collect data at hourly or fifteen-minute intervals. These data were used as the basis for rainfall temporal distributions across the region.

The NCDC data are collected at specific locations across the Central Coast region; therefore, that dataset alone could not capture the full variability of rainfall in the region. Because of gaps in the spatial coverage, there was a need to interpolate rainfall totals across the region not only to account for distance, but also for orographic influences. The PRISM Climate Group at Oregon State University maintains a meteorological data set that incorporates observed point data, a digital elevation map, and expert knowledge of complex climatic extremes (including rain shadows, coastal effects, and temperature inversions). These data cover the entire contiguous United States at a 4×4 km spatial resolution. Because the PRISM approach takes into account elevation in the spatial interpolation process, the dataset is able to better represent orographic influences in areas without gages. The only limitation of this dataset is that precipitation totals are coarsely predicted in terms of monthly volumes. The PRISM data were downloaded and processed for the period between October 1948 and September 2010 to be consistent with the period of record for which the NCDC data had been processed previously.

Using both of these data products together provided both the temporal resolution (daily NCDC rainfall totals) and the spatial resolution (grid-based PRISM coverage) required to derive isohyetal maps for the Central Coast regional study area. For this analysis, every PRISM grid in the Central Coast region was assigned to the nearest NCDC gage. The monthly time series of PRISM data were then essentially used as scaling factors to spatially adjust the associated NCDC time series data. Because the project specifically requested that the methodology outlined in EPA's EISA Technical Guidance Manual be used to calculate the 85th and 95th percentile rainfall depths, the resulting rainfall dataset for generating the isohyetal maps was comprised of 1,853 PRISM grids (each covering a 4×4 km square) of the Central Coast region, disaggregated down from monthly to a daily time step. Below is a list of steps used for developing the 85th and 95th percentile 24-hour rainfall depths for each of the 1,853 4×4 km grid cells in the region.

1. All days with measurable rainfall were queried and sorted. Days with rainfall totals of less than 0.1 inches were eliminated from the dataset to be consistent with the methodology outlined by EPA's EISA Technical Guidance Manual.

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2. The 85th percentile rainfall value was calculated for each 4×4 km grid (Figure 1).

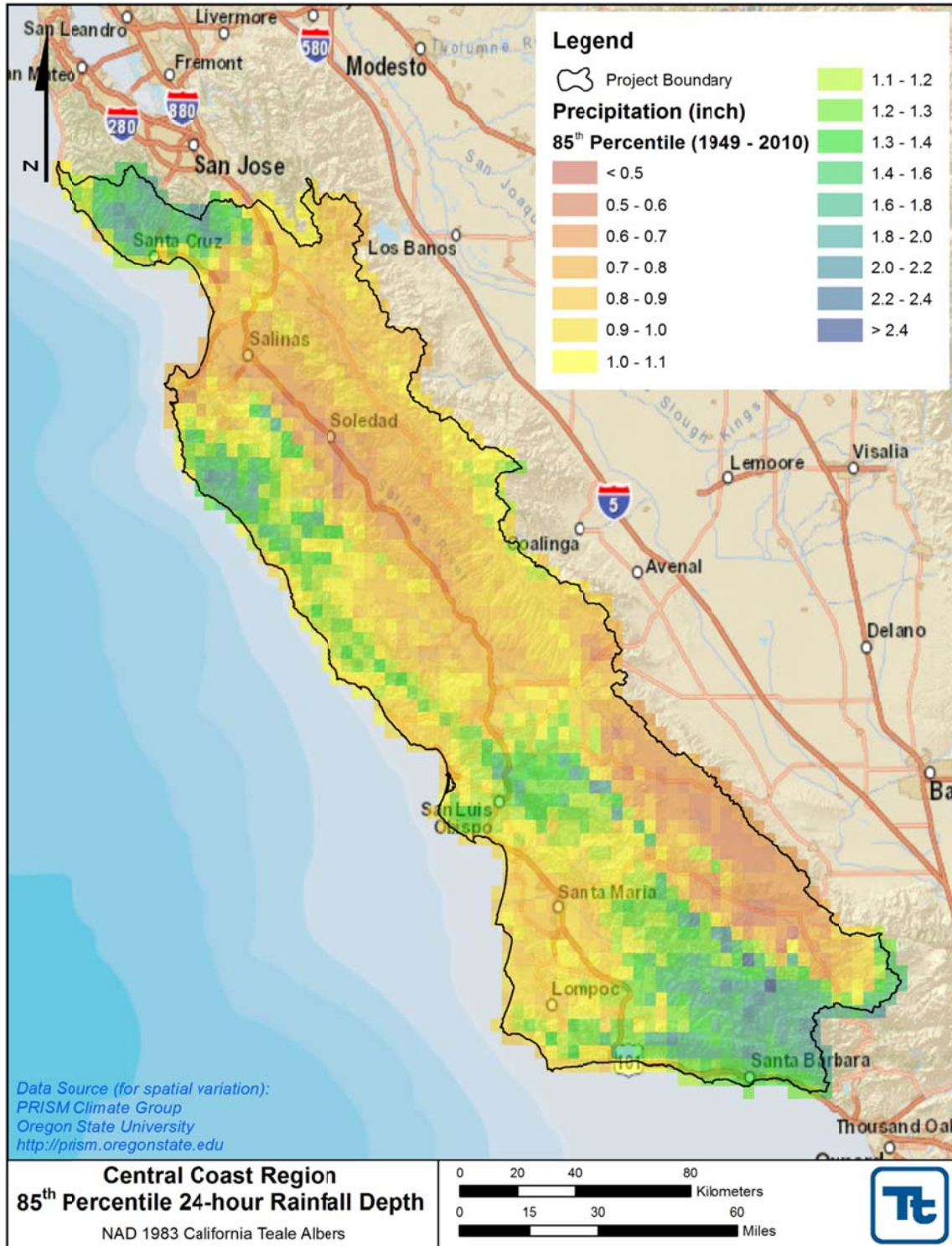


Figure 1. 85th percentile 24-hour rainfall depth map (without smoothing).

3. A 0.1 inch interval legend scale was applied to all of the map for rainfall depth, with the lowest category containing depths less than 0.4 inches.
4. The results from the 24 nearest input sample points (as conceptually illustrated in Figure 2) were used in the inverse distance weighted (IDW) method to create the contour lines for the map. This yielded smoother spatial variation and map contours, as seen in Figure 3 and Figure 4.

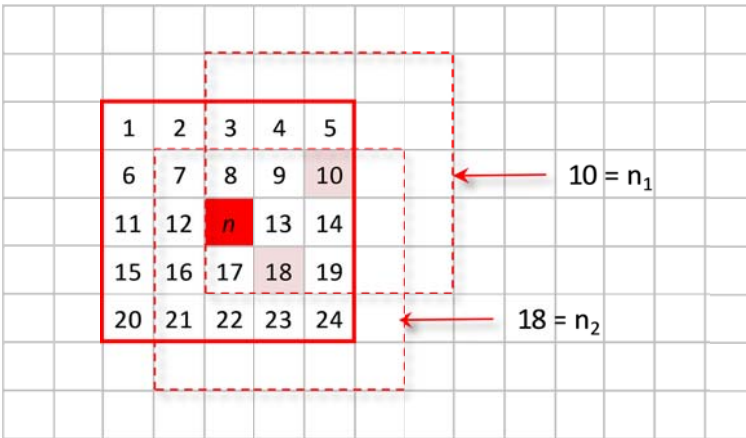


Figure 2. Conceptual diagram showing the spatial averaging domain for each grid cell n .

5. The color contours were rendered as semi-transparent (50 percent) and overlaid on the World Street base map available from ESRI through ArcGIS 10, which includes planimetric features for reference purposes, such as roads and rivers.
6. The final map was exported as interactive portable document format (PDF), designed for printing at a 4-ft wide by 5-ft high spatial extent. Using this special feature, the exported map preserved select GIS layers and georeferencing information within PDF file format. The free version of Adobe Reader can be used to interact with the map. It allows the user to turn on or off individual layers within the PDF map itself. It also allows user to see the spatial coordinates (latitude and longitude) of the cursor position on the document.

These six steps were repeated to create the 95th percentile 24-hour storm depth maps. Figure 5 plots storm depths for the 4×4 km grids without smoothing. Figure 6 shows the map after smoothing. Figure 7 shows the smoothed map with contour lines.

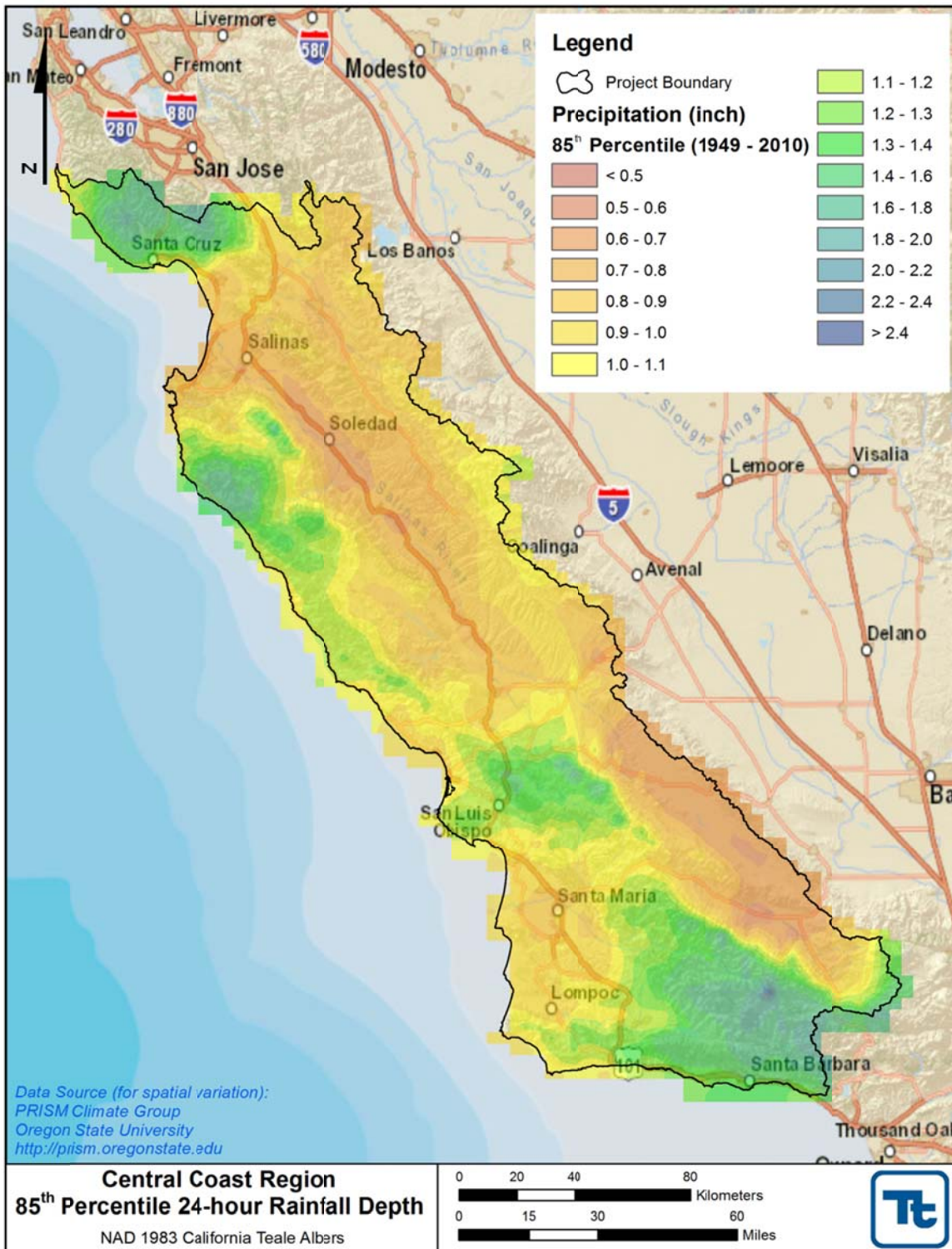


Figure 3. 85th percentile 24-hour rainfall depth map (after smoothing).

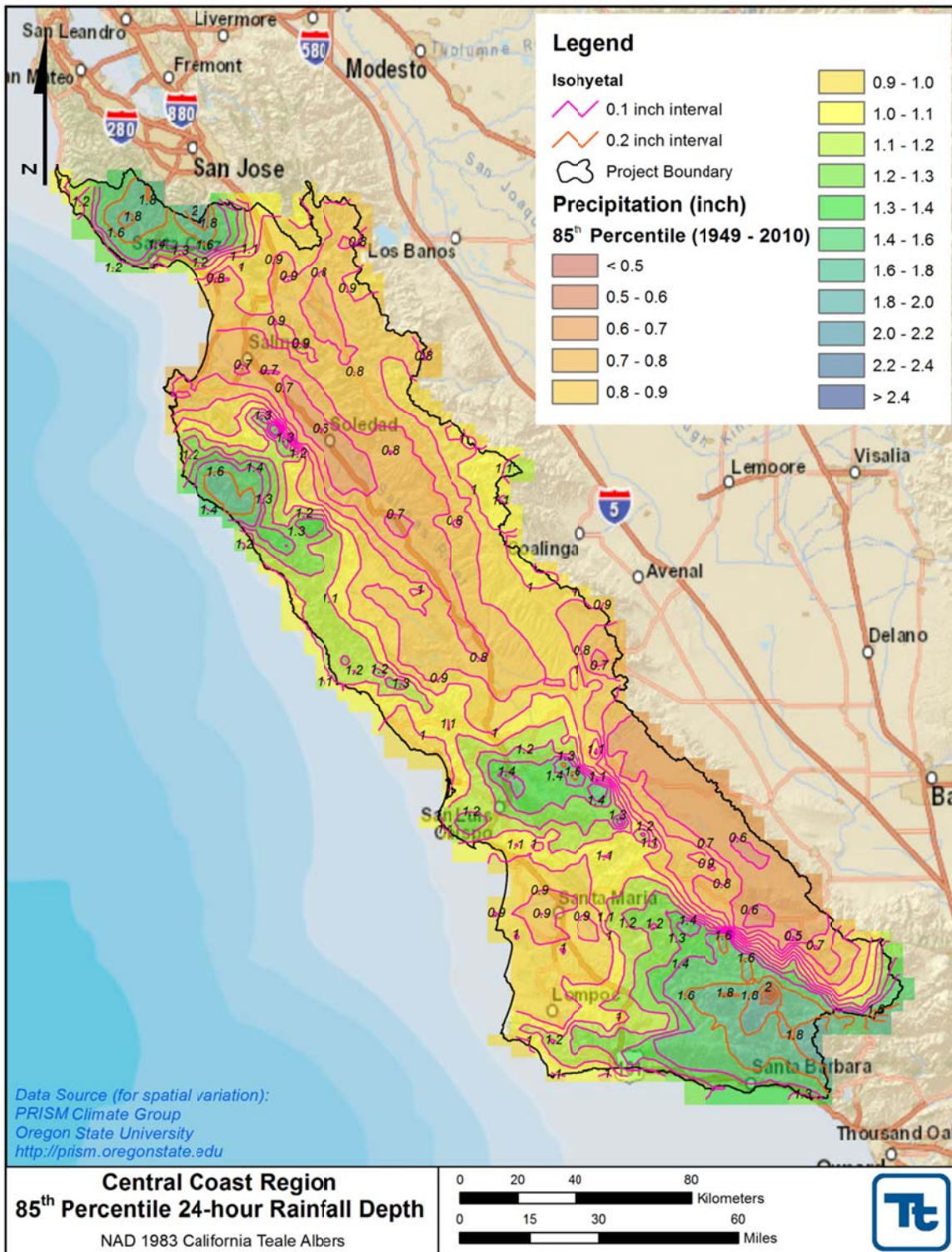


Figure 4. 85th percentile 24-hour rainfall depth map (after smoothing and with contours).

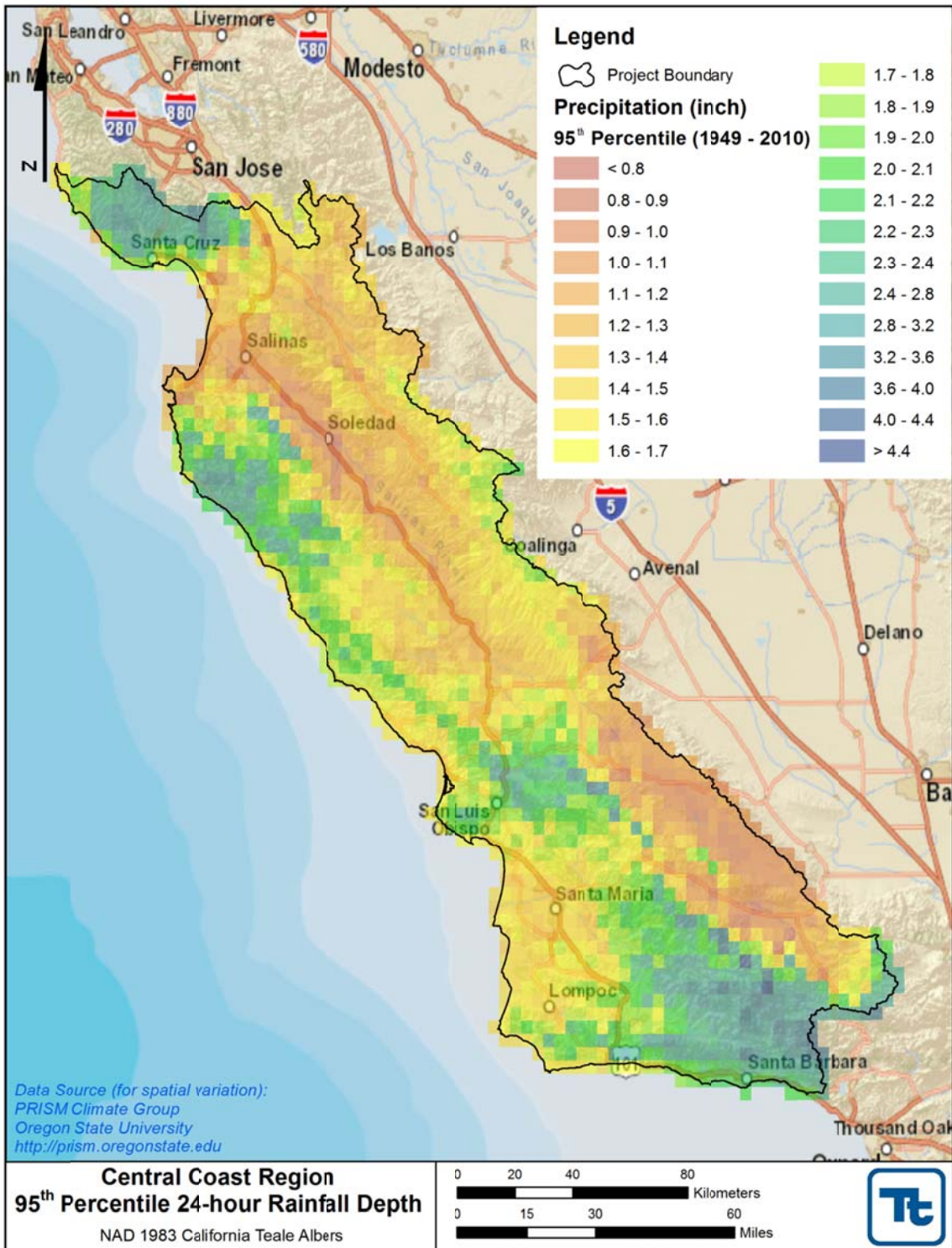


Figure 5. 95th percentile 24-hour rainfall depth map (without smoothing).

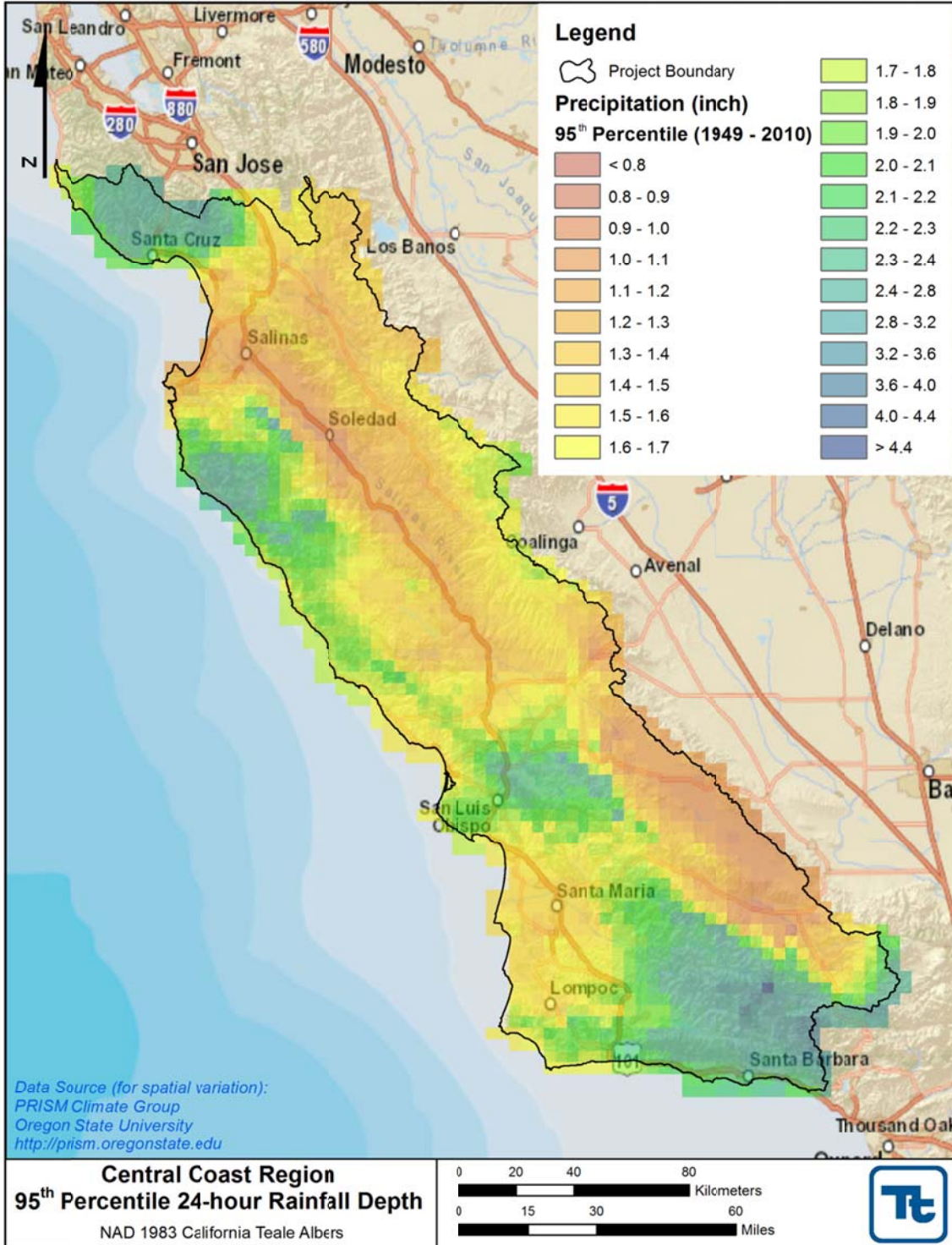


Figure 6. 95th percentile 24-hour rainfall depth map (after smoothing).

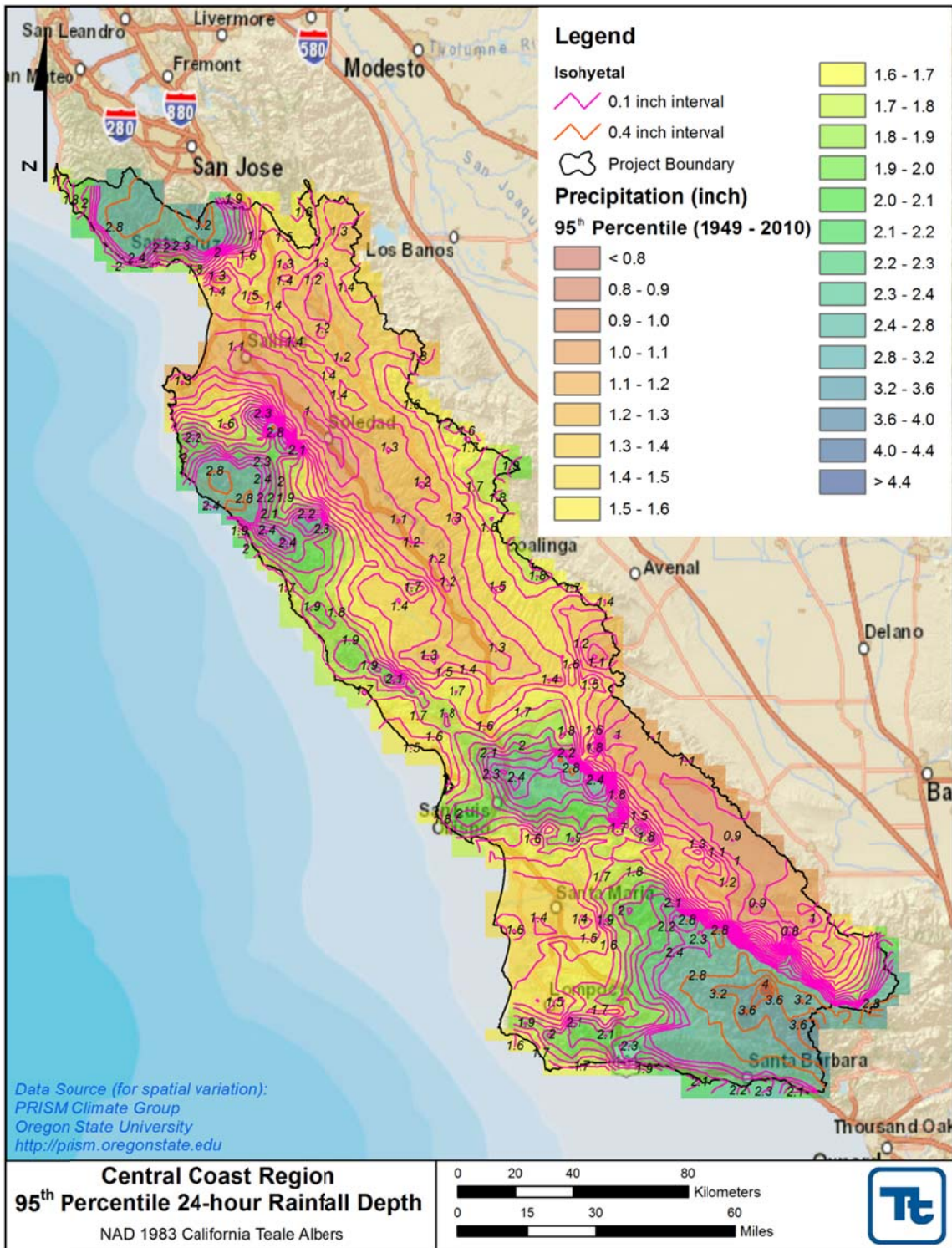


Figure 7. 95th percentile 24-hour rainfall depth map (after smoothing and with contours).



The Interactive PDF Precipitation Tool

Because of the region's diverse climates, precipitation depths for the 85th and 95th percentile storms range dramatically from one municipality to the next, and in some cases within the boundaries of a municipality itself. It is therefore important to provide interested parties with a reliable tool to estimate the appropriate design depth for individual locations. This tool provides easy access to the data and allows the user to identify the exact location of a proposed project and determine the appropriate design depth. The following pages include a brief step-by-step guide for using the interactive PDF poster files.

User Instructions for the Interactive PDF Precipitation Tool

1. Open the PDF file in Adobe Reader (version 9 or later).
2. Click the “Layers” toolbar icon on the left panel to open the list of layers available within the document (shown in Figure 8 and Figure 9 below) to view and show/hide individual layers.

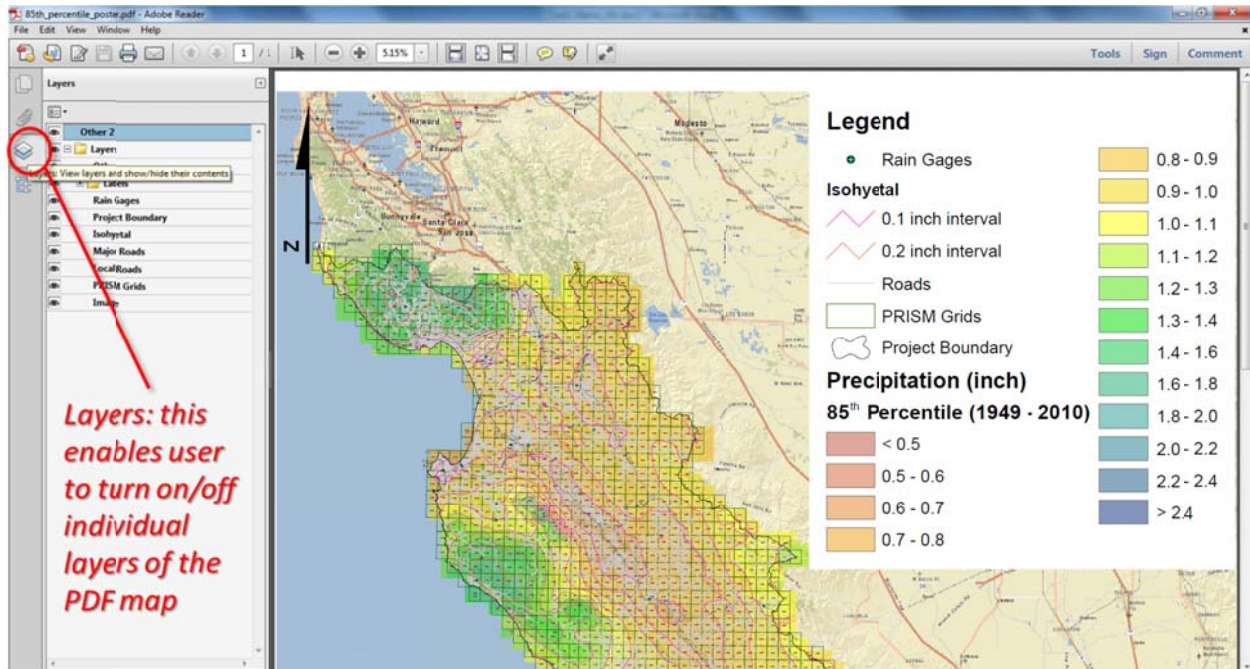


Figure 8. Access the layers within the PDF map by clicking the “Layers” toolbar icon.

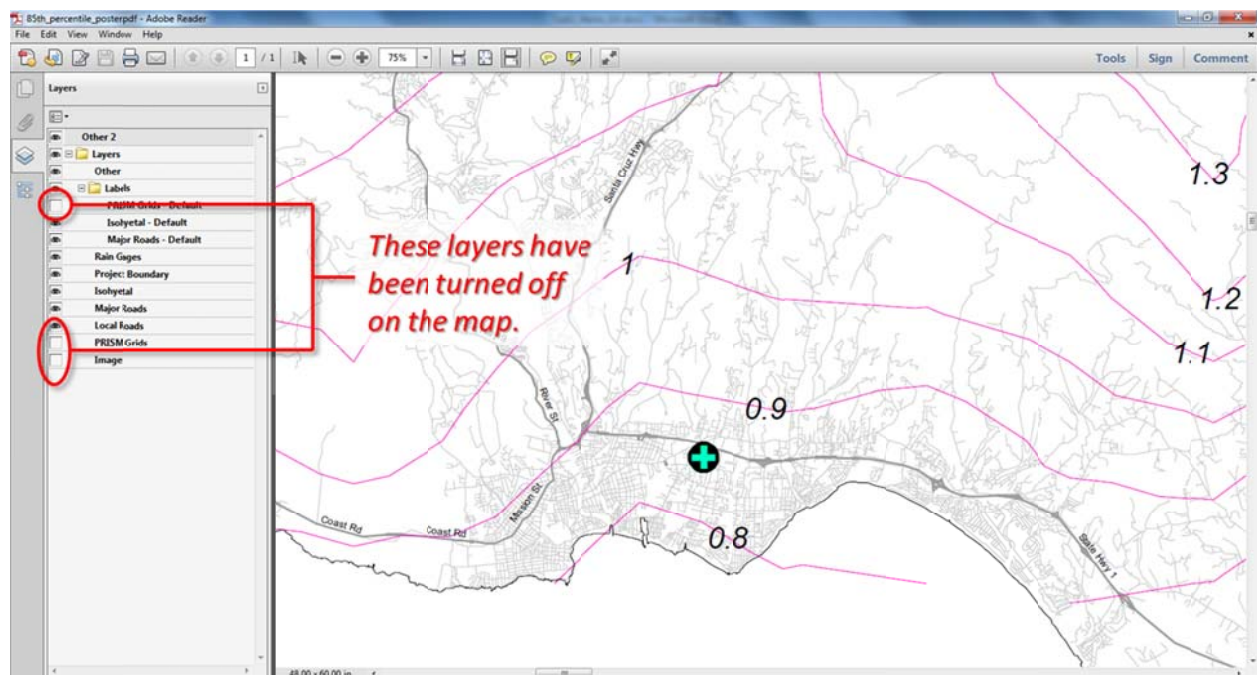


Figure 9. Turn on or off individual layers by clicking the icon beside the layer name.

- The document has been set up to allow users to view attribute information for isohyetal contour lines and rain gauge stations. To view attribute information, click the “Model Tree” icon on the left panel to open the list of layers within the PDF file that have attribute information, as shown in Figure 10. Note that when zooming into specific areas on the map, the individual labels for isohyetal contours may not be visible so it is important that the user use this attribute feature to determine the contour line value. Rain gauge attribute data is provided for informational purposes. Also note that the mouse may need to be clicked several times to successfully select the individual lines or rain gauge stations.

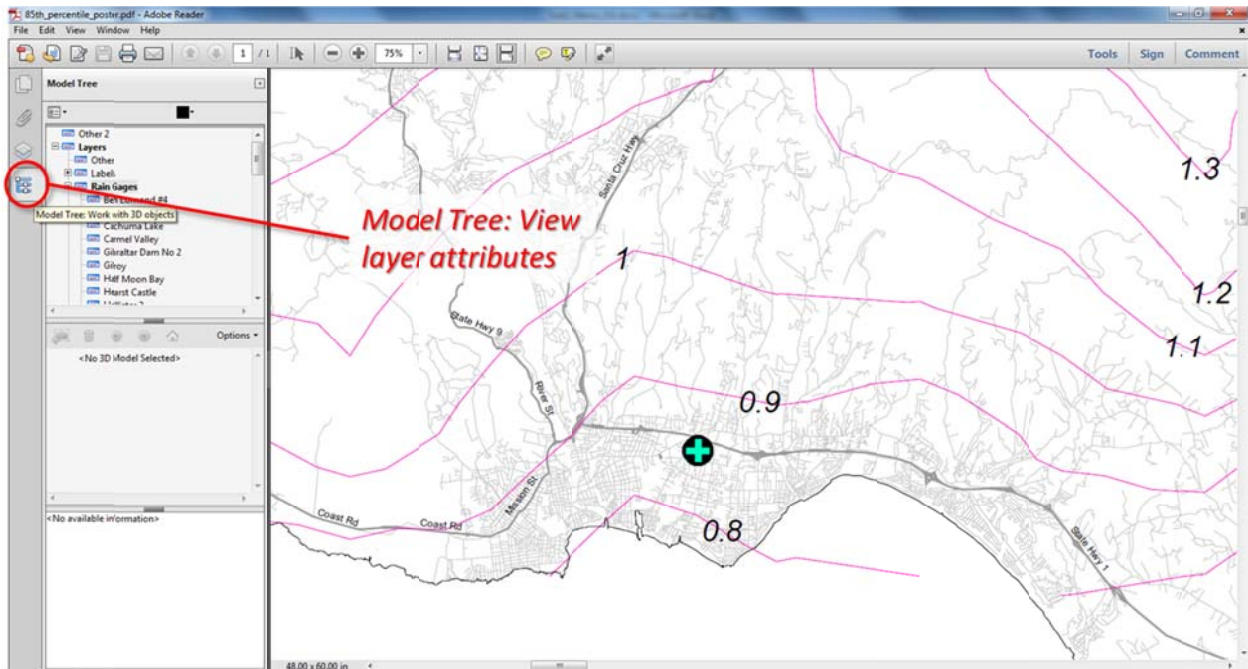


Figure 10. Use the “Model Tree” to access layer attribute information.

- To enable the special cursor for viewing attribute information by clicking directly on map features, select the “Object Data Tool” under the Edit → Analysis menu, as shown in Figure 11. Another way to view rain gage attribute information is to directly click on name of the rain gage in the “Model Tree” window. Just as clicking on the icon does, clicking the gage name in the top list will also display the full attributes data in the window below, as shown in Figure 12.

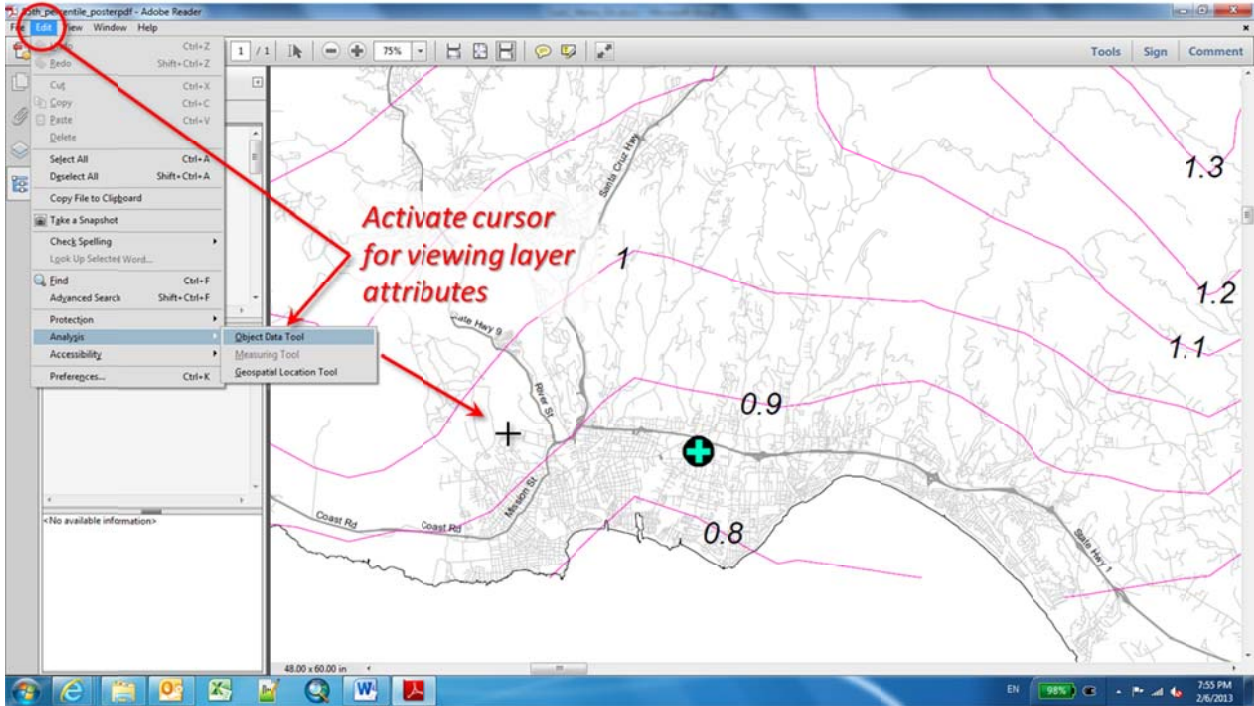


Figure 11. Activate the special cursor for viewing layer attributes through the Edit → Analysis toolbar.

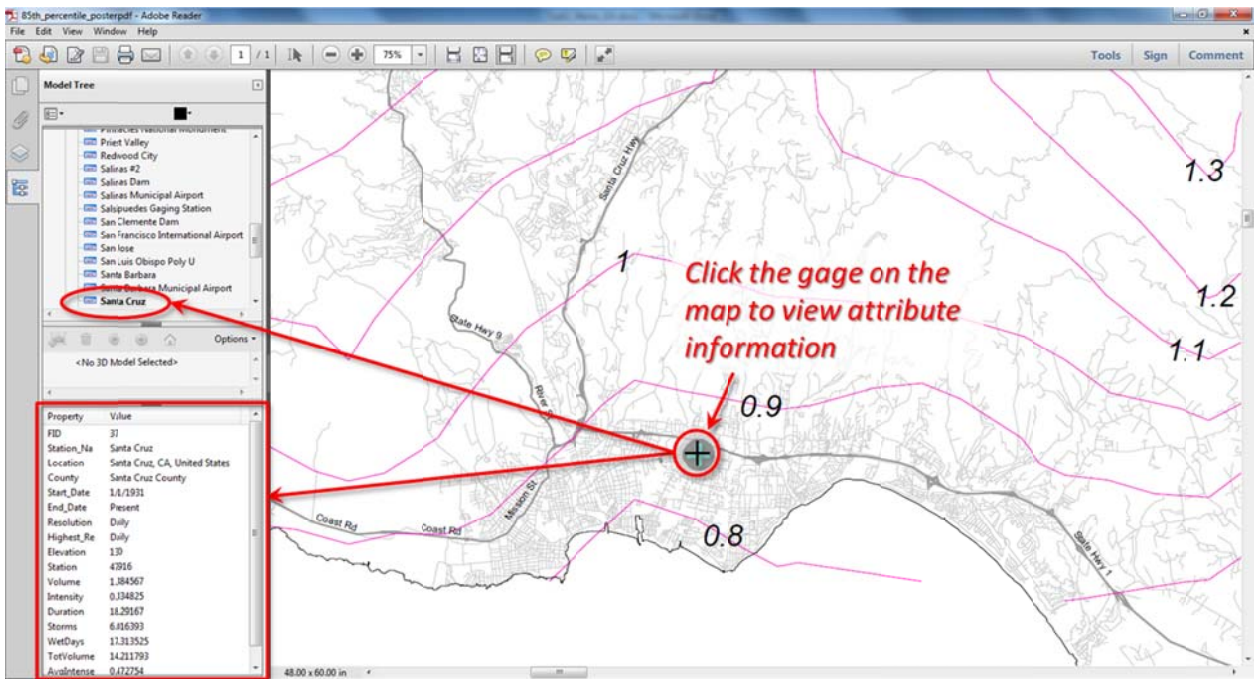


Figure 12. Click directly on shape item in the Model Tree window to view associated properties below.

- To view the georeference information (i.e. latitude and longitude) of any location on the map select the “Geospatial Location Tool” also found under the Edit → Analysis menu. To view the latitude and longitude of a point on the map, simply move the cursor to the desired location. The information will be displayed at the bottom right corner of the map, as shown in Figure 13.

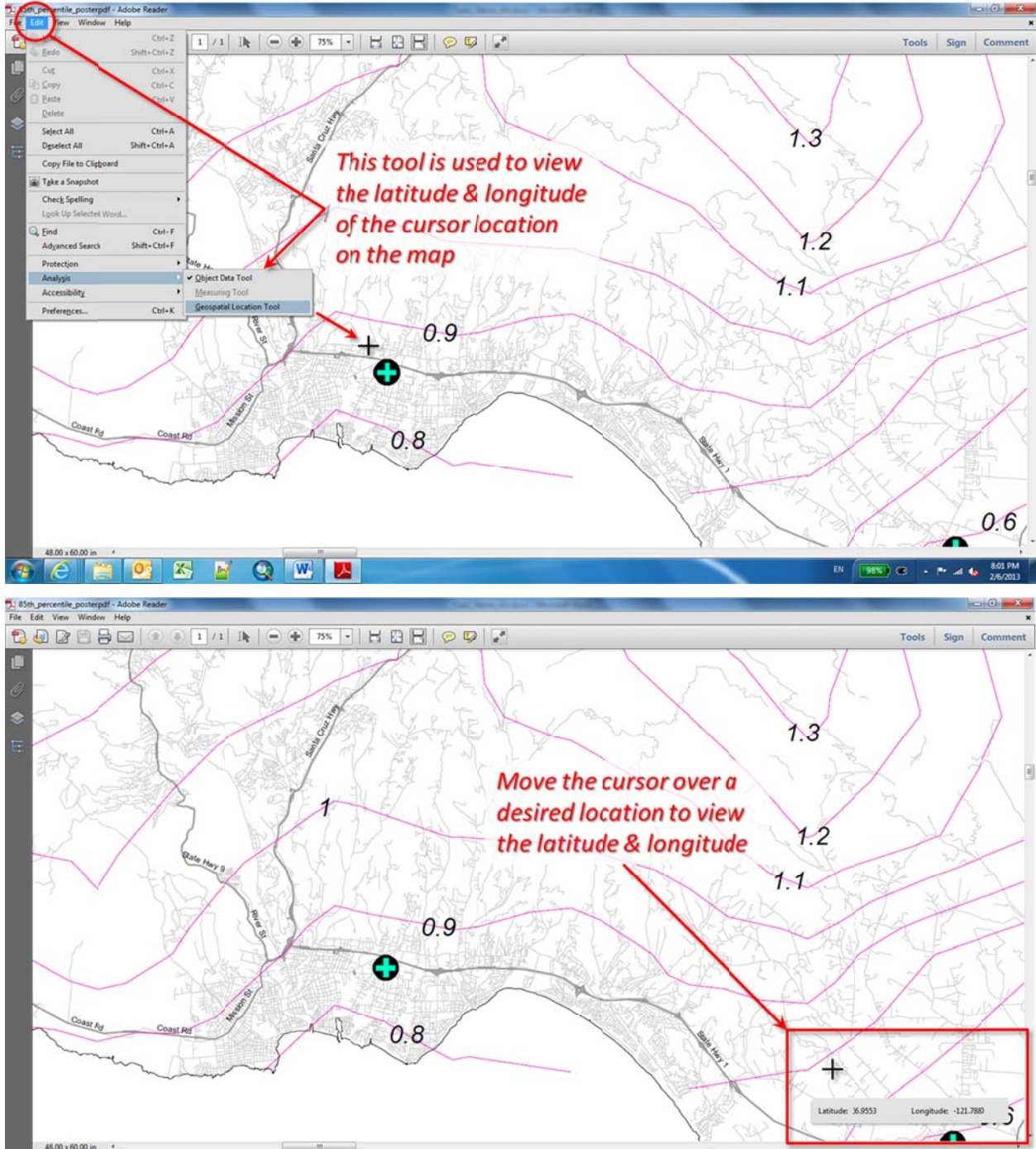


Figure 13. Use the “Geospatial Location Tool” to view the latitude and longitude of any point on the map.