Tuscan Aquifer INVESTIGATION

Final Report Excerpt:
Hydrostratigraphy

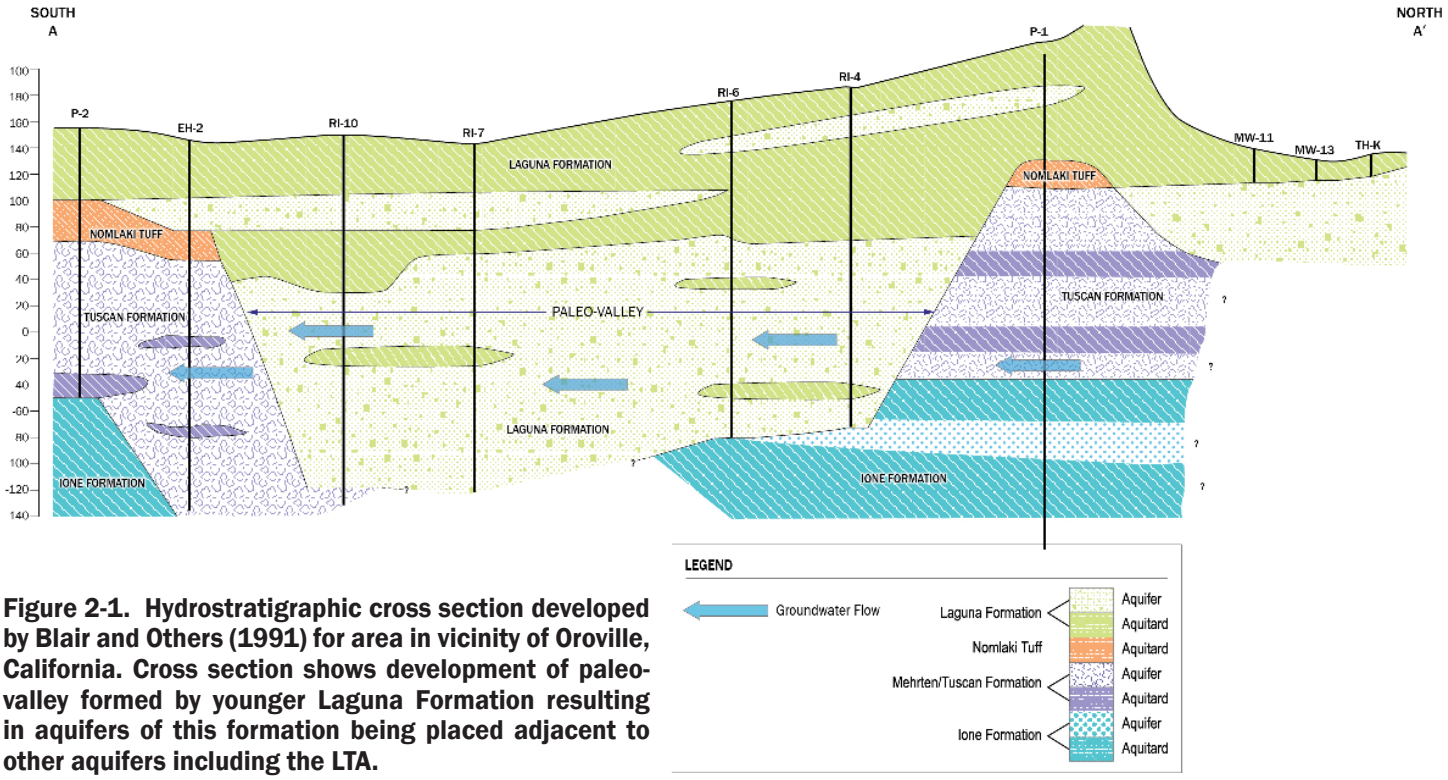

Figure 2-1. Hydrostratigraphic cross section developed by Blair and Others (1991) for area in vicinity of Oroville, California. Cross section shows development of paleo-valley formed by younger Laguna Formation resulting in aquifers of this formation being placed adjacent to other aquifers including the LTA.

As part of the Lower Tuscan Aquifer (LTA) project, the identification of both geologic and hydrogeologic units is critical to the overall understanding of how groundwater flows through the environment. Identification of **geologic formations,** such as the Tuscan Formation, should be based on explicit practices for classifying and naming all formally defined geologic units as presented in the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature (NACSM, 2005).

The formation (always capitalized when used for geologic unit, i.e. Tuscan Formation) is the fundamental unit in lithostratigraphic (layers of rock in the ground) classification. As defined by the NACSM (2005), "a formation is a body of rock identified by lithic (rock or stone) characteristics and stratigraphic position; it is prevailingly but not necessarily tabular and is mappable at the Earth's surface or traceable in the subsurface." The key portion of this definition for the LTA project is mappable, or easily identified, at the Earth's surface or traceable in the subsurface. For the LTA, characteristics easily identifiable in **drill cuttings** (material from the ground when drilling a well) were critical to the identification of geologic formation boundaries. For example, the Tuscan Formation was identified in drill cuttings collected from soil borings completed as part of the LTA project following the criteria of Blair and others (1991) that distinguished this unit of material from overlying units by the significant presence (greater than 50 percent) of volcanic rock types referred to as andesite, andesitic basalt, and/or dacite. In contrast, the numerous Quaternary formations used by others in the area are based on geomorphic or buried-soil information rather than on criteria by which formal formations are distinguished. More importantly, the criteria used by others cannot be easily distinguished in drill cuttings. For the LTA Project, these units were defined to include all post-Tuscan sediments in the area and were designated as Quaternary Deposits.

Both the Quaternary Deposits and distal portion of the Tuscan Formation primarily consist of **fluvial** deposits, or deposits formed from the processes of rivers and streams. The term **distal** refers to areas farthest away from the source of rock material making up the sediments as opposed to **proximal**

that indicates portions of the geologic formation nearest the source of rock material. Characteristic of former river systems is the deposition of interbedded sands, gravels, silts and clays whereby the sand and gravel units represent material deposited within the high velocity flows of the main river channels and the silts and clays represent material deposited within areas of low velocity flows such as the floodplains. This type of depositional environment forms subsurface features referred to as **"paleo-valleys"** that represent areas of former canyons that have been filled in with coarse grained sediments. The paleo-valley is represented by the thick sequence of sands and gravel deposits from the younger Laguna Formation **juxtaposed** (deposited adjacent to) older deposits of the Tuscan Formation. The LTA project report notes that the identification of these types of features will be critical to the overall understanding of groundwater movement within the LTA and interactions with other aquifer systems as discussed below for hydrogeologic unit classification. It is also important to note, that identification of these features requires detailed analysis of drill cuttings and identification of geologic formation boundaries.

The Tuscan Formation includes a sequence of variably cemented, interbedded clay, sand, and gravel. This formation consists predominantly of purple volcanic debris flow deposits and interbedded waterlain fluvial deposits rich in volcanic material produced by erosion, but in many areas containing crystalline basement-derived clasts and rare tuff beds. The reported occurrence of both channel-lain, clast supported, pebble- and cobble-gravel facies and interbedded volcanic-rich debris-flow facies in this formation suggests that debris flows related to volcanic events episodically choked the ancestral stream/river systems of the area (Blair and others, 1991). In contrast, the Tehama Formation to the west of the study area consists predominantly of metamorphic clasts originating from the Coast Ranges.

Helley and Hardwood (1985) divided the Tuscan Formation into four hydrostratigraphic units, labeled from deepest to shallowest, A through D. Units A and B together define the LTA, the subject of this study, and units C and D define the Upper Tuscan Aquifer. It should be noted that although an attempt was made to distinguish these units from drill cuttings during the drilling of monitoring wells for the LTA project, the Helley and Harwood definitions of A through D are generalizations derived from the outcrop that have not been established in the subsurface. The approximate extent of the LTA within the project boundaries is shown on Figure 3-10 of the report. Helley and Hardwood (1985) also identified several tuffaceous units that were used to separate the hydrostratigraphic units that included the Tuff of Hogback Road (separates Unit D from Unit C), Ishi Tuff Member (separates Unit C from Unit B), and the Nomlaki Tuff Member (top of Unit A).

Geologic units underlying the Tuscan Formation within the project area are the Miocene Lovejoy Basalt and Eocene Ione Formation.