



# The Deep Aquifers



# Deep Aquifers, what are they?

- ▶ The Deep Aquifers refer to all the water-bearing sediments beneath the 400-Foot Aquifer in the 180/400-Foot Aquifer Subbasin, or their equivalent in neighboring the subbasins: Monterey, Forebay, Langley, and Eastside (Hanson, 2002).

Generalized Geologic-Hydrogeologic relationships; highlighting Deep Aquifers

(Modified from: 2017 Monterey County Water Resources Agency's Recommendations to address the expansion of seawater intrusion in the Salinas Valley groundwater basin report. )

| Period/Epoch                     |                           | Formation                    | Hydrostratigraphy                                     |
|----------------------------------|---------------------------|------------------------------|---|
| Quaternary<br>2.5 MYA to present | Holocene                  | Recent Alluvium              | Shallow Aquifer<br>Dune Sand Aquifer                  |
|                                  | Pleistocene               | Valley Fill                  | Salinas Valley Aquitard                               |
|                                  |                           | Aromas Sands<br>(near coast) | 180-Foot Aquifer<br>180/400-Foot Aquitard             |
|                                  |                           | <b>Paso Robles</b>           | 400-Foot Aquifer<br>400-Foot/Deep Aquitard            |
|                                  | Tertiary<br>23 to 2.5 MYA | Pliocene                     | <b>Purisima /<br/>Pancho Rico<br/>Santa Margarita</b> |
| Miocene                          |                           | Monterey                     | Minimally Water-Bearing                               |
| Mezozoic                         |                           | Granitic Basement            | Non Water-Bearing                                     |





## References on the Deep Aquifers in the Forebay Subbasin

| Source   | Summary   |
|--|---|
| Thorup, 1976 (USGS)                                | <p>“Fourteen wells, stretching between the Prunedale Hills and King City, have been perforated solely in the Deep Zone.” (page 3)</p> <p>“Southeast, toward the valley towns of Greenfield and King City, a distance of some 60 miles from Moss Landing, indications are that the deep zone continues up the Salinas Valley beneath the valley alluvium in sufficient thickness and permeability to be a continuous viable aquifer.” (page 5)</p>   |
| DWR, Bulletin 118, 3-4.04 Forebay Aquifer Subbasin | <p>“An additional deeper aquifer (also referred to as the 900-Foot Aquifer or the Deep Aquifer) is present in the lower and central Salinas Valley, including beneath the Forebay Aquifer Subbasin.” (page 2)</p>   |
| Brown & Caldwell, 2015 (MCWRA)                     | <p>“The Pressure Deep Aquifer found in the Pressure and East Side Subareas is also present in the Forebay Subarea.” (page 3-10)</p>   |
| MCWRA, 2017  | <p>“The Deep Aquifers have been mapped at locations as far inland as the south-southeast edge of the city of Salinas (Kennedy/Jenks, 2004). However, the geologic units that comprise the Deep Aquifers – the Paso Robles and Purisima formations – are present throughout the 180/400 Foot Aquifer Subarea. Formations comprising the Deep Aquifers occur closer to the surface with increasing distance toward the southern Salinas Valley, i.e. with the transition into the Forebay Subarea (Brown and Caldwell, 2015).” (page 56 of 244)</p> |
| MCWRA, 2018 (Roundtable Presentation)              | <p>“Thorup (1976) estimated that the Deep Aquifers extended from Greenfield to the mouth of the Salinas River” (page 37 of 38)</p>  |



# References on the Deep Aquifers

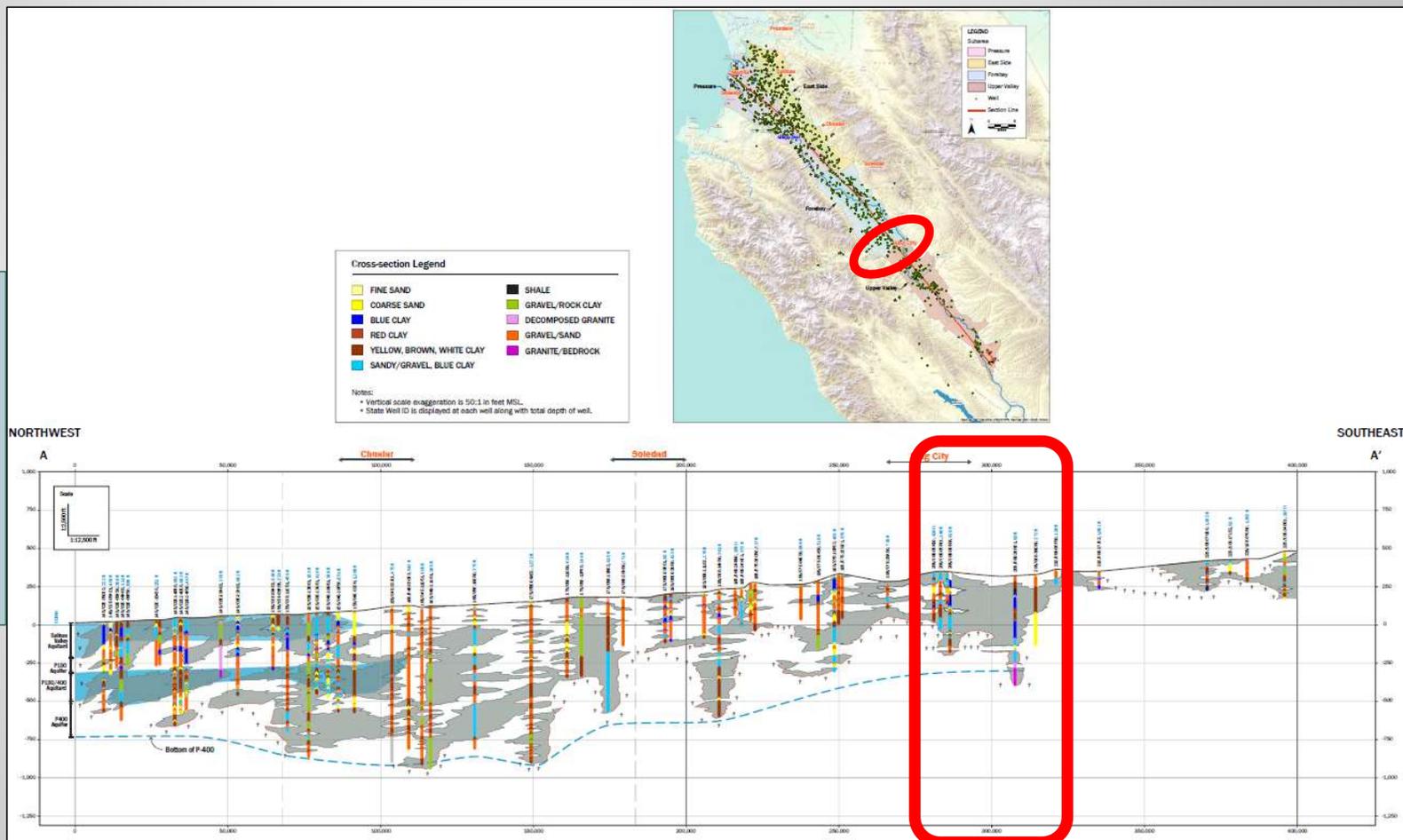
| Source                         | Summary   |
|--------------------------------|---|
| Brown & Caldwell, 2015 (MCWRA) | The Deep Aquifers include distinct aquifers zones located at approximate depths of 800, 900, 1,000, and 1,500 feet below ground surface. Also found in the Forebay Subarea.                                     |
| Feeney & Rosenberg, 2003       | This technical memorandum attempts to provide geologic assignments for the sediments encountered in these deeper wells such that a hydrogeologic framework can be developed. Focused along the coast.           |
| Greene, 1970 (USGS)            | Geologic description, with discussions of formations cropping out along the walls of Monterey Submarine Canyon.   |
| Hanson et al, 2002 (USGS)      | This study is largely limited to data obtained from one monitoring-well site near the coast; no broader or more detailed interpretations of the regional geology and hydrology were made as part of this study. |
| HydroMetrics, 2009             | Groundwater model report for the Seaside Water Master. Breaks each geologic unit into distinct aquifers for modeling purposes. Models Seaside and Monterey Subbasins together.                                  |
| MacTec Engineering, 2005       | Technical report summarizing the drilling and installation of Deep Aquifers wells near the coast.   |
| MCWRA, 2017                    | What data exist are concentrated largely near the coast, where the most wells have been drilled into the Deep Aquifers.   |
| MCWRA, 2018                    | From 2016 extraction data, 81% of pumping from wells in coastal Deep Aquifers, 18% of pumping from wells in inland Deep Aquifers.   |
| MCWRA, 2020                    | Summarized Ordinance 5303, which prohibited new wells within a defined area of impact for seawater intrusion.   |
| Thorup, 1976 (USGS)            | Extent: Seaside to Springfield-Moro-Cojo District (South to North): Coast to ~ Greenfield, possibly San Ardo where it is called the Paso Robles Formation   |

# Deep Aquifers, where are they?



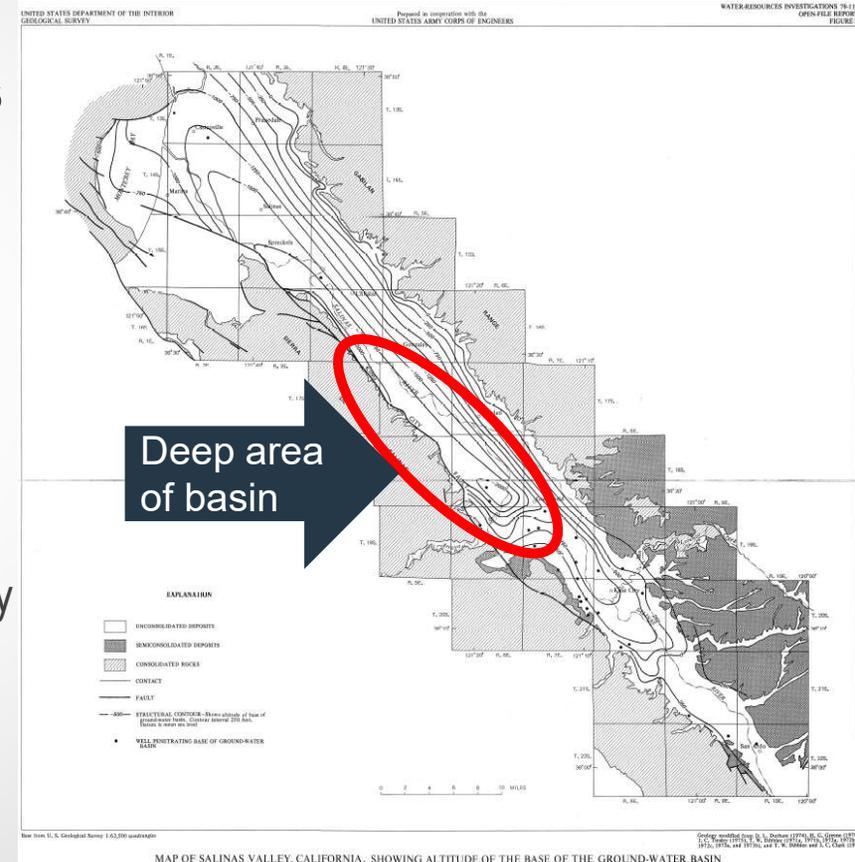
Valley-Length cross section; highlighting basin bottom transition near Forebay-Upper Valley boundary

(2015 Brown & Caldwell's *State of the Salinas River Groundwater Basin - Hydrology Report*)



## Conclusion: Deep Aquifers in the Forebay Subbasin

- The southern extent of the Deep Aquifers is unknown, however there is information that led us to believe the Deep Aquifers is present in the Forebay Subbasin:
  - USGS and MCWRA reports
  - Deep wells in and near the Forebay Subbasin
  - Brown & Caldwell, 2015 cross-section shows the basin bottom doesn't rise until closer to the Forebay-UV boundary
  - Durbin et. al., 1978 valley flow model shows depth to basin bottom (right) where the deep area extends to almost Greenfield





## Conclusion: Deep Aquifers in the Forebay Subbasin

- Depth of Forebay Subbasin is consistent with the depth of the Deep Aquifers
- Previous studies suggest the Deep Aquifers are geologically equivalent to the deeper parts of the Forebay Aquifer.
- But ... no conclusive evidence of the southern extent of the Deep Aquifers (as a unique aquifer)
- Now treated as one principal aquifer
- Deep Aquifers study is forthcoming from MCWRA