WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

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SPECIFIC CAPACITY — A MEASURE OF WELL PERFORMANCE, WELL PROBLEMS, AND AQUIFER TRANSMISSIVITY: PART 1 OF 2

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The WRD is pleased to present this latest edition of our Technical Bulletin series to provide information on the Central and West Coast groundwater basins of Los Angeles County, California. We welcome any questions or comments to this bulletin or for suggestions on topics for future editions.

What is Specific Capacity?

The Specific Capacity of a well is simply the pumping rate (yield) divided by the drawdown (**Figure 1**). It is a very valuable number that can be used to provide the design pumping rate or maximum yield for the well. It can be used to identify potential well, pump, or aquifer problems, and accordingly to develop a proper well maintenance schedule. It can also be used to estimate the transmissivity of the aquifer(s) tapped by the well's perforations. Transmissivity is the rate water is transmitted through an aquifer under a unit width and a unit hydraulic gradient. It equals the aquifer's hydraulic conductivity (permeability) times the aquifer thickness. The higher the transmissivity, the more prolific the aquifer and the less drawdown observed in the well.

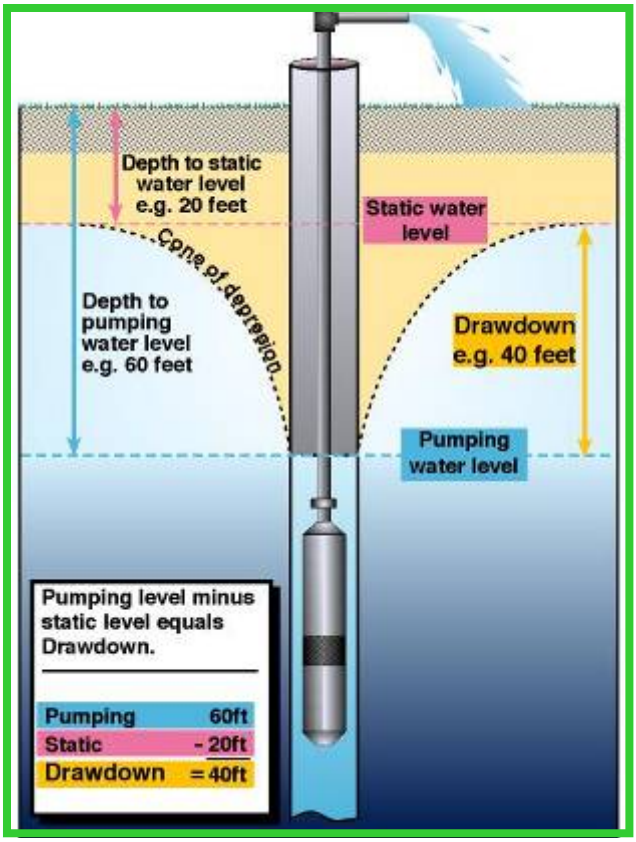
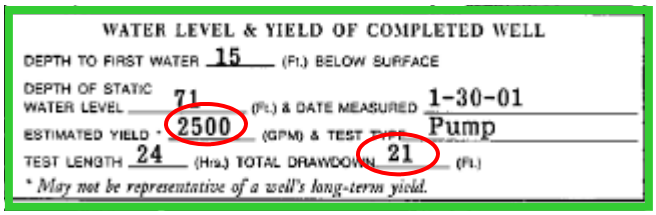


Figure 1 - Drawdown in a well. From Ohio Department of Natural Resources

Typically, a well should run continuously for at least 24 hours at a constant yield before recording the drawdown (Driscoll, 1986). The same time frame should be used for each subsequent test for equal comparisons to the initial test. Shorter time frames are sometimes used from electric company pump efficiency tests or Step-Drawdown tests, but these shorter times may not sufficiently allow the water levels to stabilize for a reliable Specific Capacity calculation.

Figure 2 shows information from a typical well driller's log for a well in the Central Basin. The pumping test was run for 24 hours when the yield (2,500 gpm) and the drawdown (21 feet) were measured. The Specific Capacity is calculated as 2,500 gpm/21 feet, or **119 gpm/ft**.


WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 15 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 71 (Ft.) & DATE MEASURED 1-30-01

ESTIMATED YIELD * 2500 (GPM) & TEST TYPE Pump

TEST LENGTH 24 (Hrs.) TOTAL DRAWDOWN 21 (Ft.)

* May not be representative of a well's long-term yield.

Figure 2 - Information from a Well Driller's Log showing variables for Specific Capacity.

The Specific Capacity obtained just after a well is drilled and properly developed is typically the highest value that will be produced and is the benchmark with which to compare all future values. As time goes by, the Specific Capacity will decline as plugging of the well's perforations or filter pack occurs, as the pump starts to fail, or as static water levels change. Specific Capacity tests should be performed at least semi-annually and water levels (static and pumping) should be collected monthly to provide early detection of potential well problems. Rehabilitation work should be initiated when a well's Specific Capacity drops by 25% (Driscoll, 1986).

The initial value can also be used to estimate the maximum pumping rate for the well. Using the above example and assuming that only 50 feet of drawdown is available in the well, the maximum yield is calculated as the Specific Capacity times the maximum drawdown, or 119 gpm/ft * 50 ft, = 5,950 gpm. This should be verified with an actual field test.

The initial Specific Capacity value can also be used to estimate the transmissivity of the aquifer. Driscoll (1986) provides the following equations to estimate transmissivity:

T = 1500 * Q/s (for an unconfined aquifer)

T = 2000 * Q/s (for a confined aquifer)

Notes:

T = Transmissivity, in gallons per day per foot, gpd/ft

Q/s = Specific Capacity, in gallons per minute per foot, gpm/ft

See Driscoll (1986) for assumptions.

Specific Capacity Values in the Central and West Coast Basins

To gain an understanding of the Specific Capacity distribution throughout the Central and West Coast Basins, WRD calculated the Specific Capacity values from 328 well driller's logs between 1920 and 2003. These values were then brought into a Geographic Information System (GIS) and gridded, contoured, and color-coded into ranges to produce the map shown as **Figure 3**. Although the wells had different pumping rates, durations of test, and lengths of screen, the map nonetheless can be used to provide some general understanding of distributions across the basins. Specific Capacity values are generally highest in the Carson and Dominguez Gap areas of the West Coast Basin, where the Silverado Aquifer sands are especially thick and transmissive. Specific Capacity values are lowest in the eastern and northern portions of the Central Basin and along the Newport-Inglewood Uplift near Gardena and Inglewood, indicative of tighter and less transmissive aquifers in those areas.

Many pumpers do not have the luxury of drilling new wells in areas of higher Specific Capacity, so this map can be used to estimate the drawdown that will occur at a new well site based on the desired pumping rate. However, confirmation with site-specific pilot hole drilling and pump testing will still be necessary for final well and pump designs

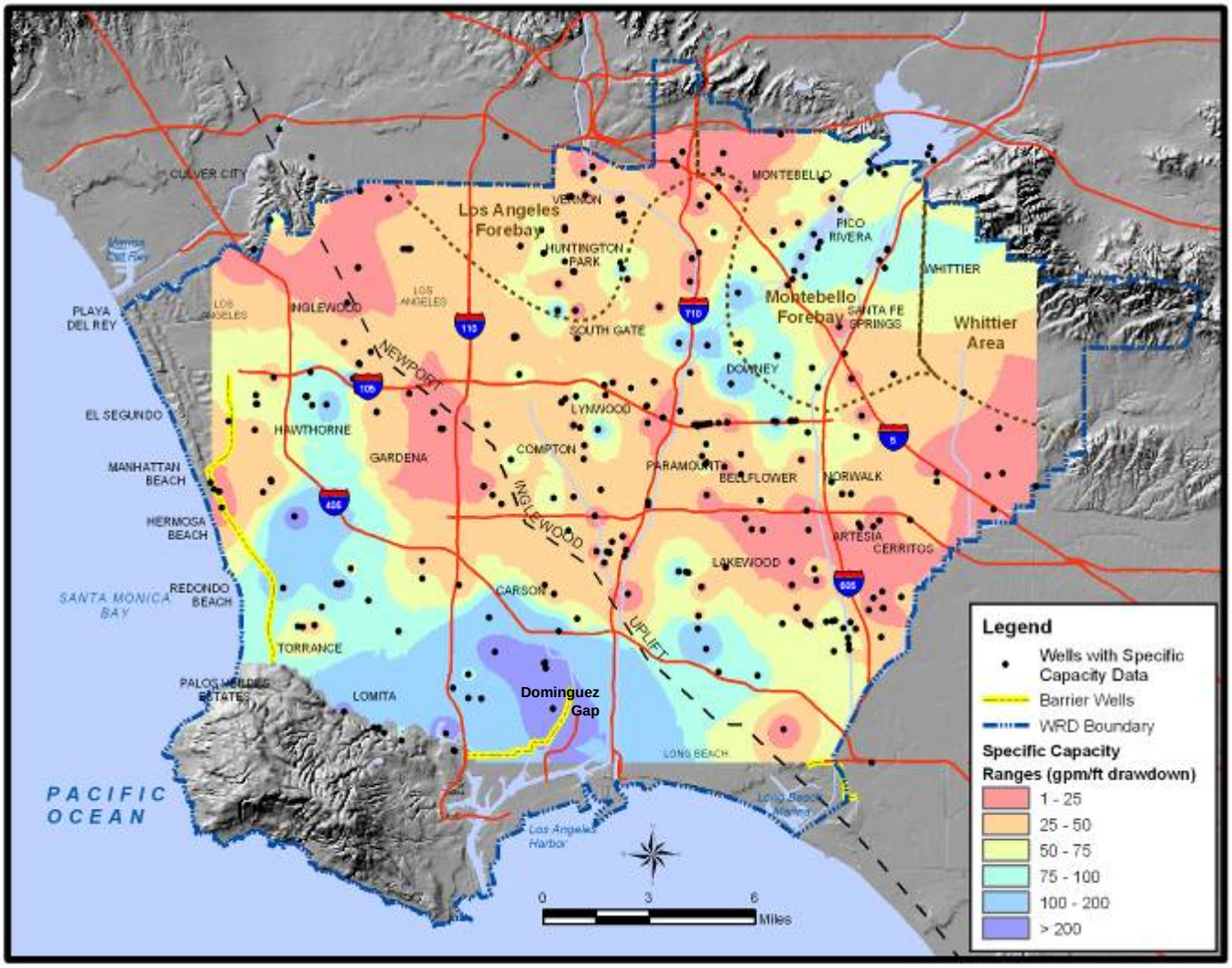


Figure 3—Specific Capacity Map based on initial values on well driller's logs.

Part 2 will focus on declining Specific Capacity values and well redevelopment. For more information on this Technical Bulletin, please contact the author at the Water Replenishment District of Southern California. Current and previous editions can be found on our web site at http://www.wrd.org.

Sources of Information for this Technical Bulletin:

Ohio Department of Natural Resources, web site accessed 2/24/05. http://www.dnr.state.oh.us/water/maptechs/Drawdown_lrg.jpg

Driscoll, F.G., 1986, Groundwater and Wells, Second Edition, Published by Johnson Filtration Systems Inc.

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