WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

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AN INTRODUCTION TO THE HYDROGEOLOGY OF THE CENTRAL AND WEST COAST BASINS

By: Ted Johnson, Chief Hydrogeologist
Email: tjohnson@wrd.org

The WRD is pleased to present the first in a series of Technical Bulletins designed to provide useful information on the groundwater resources of the Central and West Coast Basins (CWCB). Volume 1 presents an introduction to the hydrogeology of the basins, including the geology, the occurrence and movement of groundwater, and the groundwater budget. Future issues will cover topics such as seawater intrusion, computer modeling, well drilling, water quality, aquifer properties, and replenishment facts. The WRD welcomes any comments on its Technical Bulletins or suggestions for future topics.

Geology

The CWCB are two groundwater basins in the Coastal Plain of Los Angeles County. They are comprised of Quaternary-age (less than 1.8 million years old) sediments of gravel, sand, silt, and clay that were deposited in layers from the erosion of nearby hills and mountains and from historic beaches and shallow ocean floors that covered the area in the past. Underlying these Quaternary sediments are basement rocks such as the Pliocene Pico Formation that generally do not provide sufficient quantities of groundwater for pumping. Separating the Central Basin from the West Coast Basin is the Newport-Inglewood Uplift (NIU), a series of discontinuous faults and folds that form a prominent line of northwest trending hills including the Baldwin Hills, Dominguez Hills, and Signal Hill.

The Central Basin (CB) covers approximately 270 square miles and is bounded on the north by the Hollywood Basin and the Elysian, Repetto, Merced, and Puente hills, to the east by the Los Angeles County/Orange County line, and to the south and west by the NIU. The California Department of Water Resources (1961) divided the Central Basin into four sections; the Los Angeles Forebay, the Montebello Forebay, the Whittier Area, and the Pressure Area (Figure 1). The two forebays represent areas of unconfined aquifers (water table aquifers) that allow percolation of surface water down into the deeper aquifers to replenish the basins. The Whittier Area and Pressure Area are confined aquifer systems that receive relatively minimal recharge from surface water. They are replenished from the up-gradient forebays and from adjacent groundwater basins.

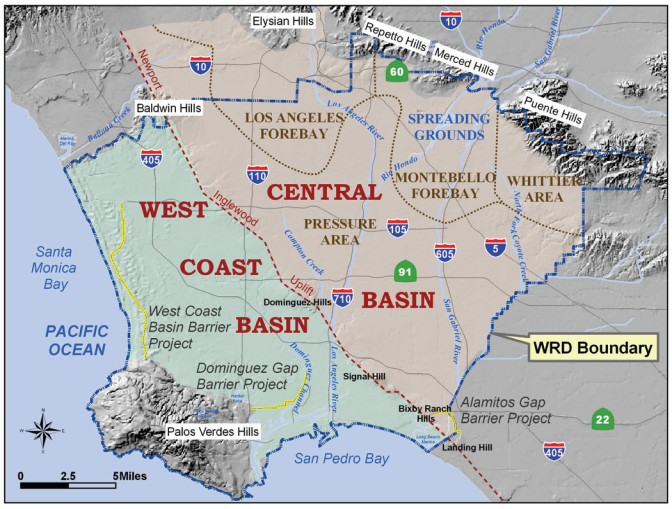

Figure 1—Map of Central and West Coast Basins

The West Coast Basin (WCB) covers approximately 140 square miles and is bounded on the north by the Baldwin Hills and the Ballona Escarpment (a bluff just south of the Ballona Creek), on the east by the NIU, to the south by San Pedro Bay and the Palos Verdes Hills, and to the west by the Santa Monica Bay. Aquifers in the West Coast Basin are generally confined and therefore receive the majority of their natural recharge from groundwater underflow from adjacent basins or from continued seawater intrusion in certain areas. Figure 2 is a generalized geologic cross section through the CWCB.

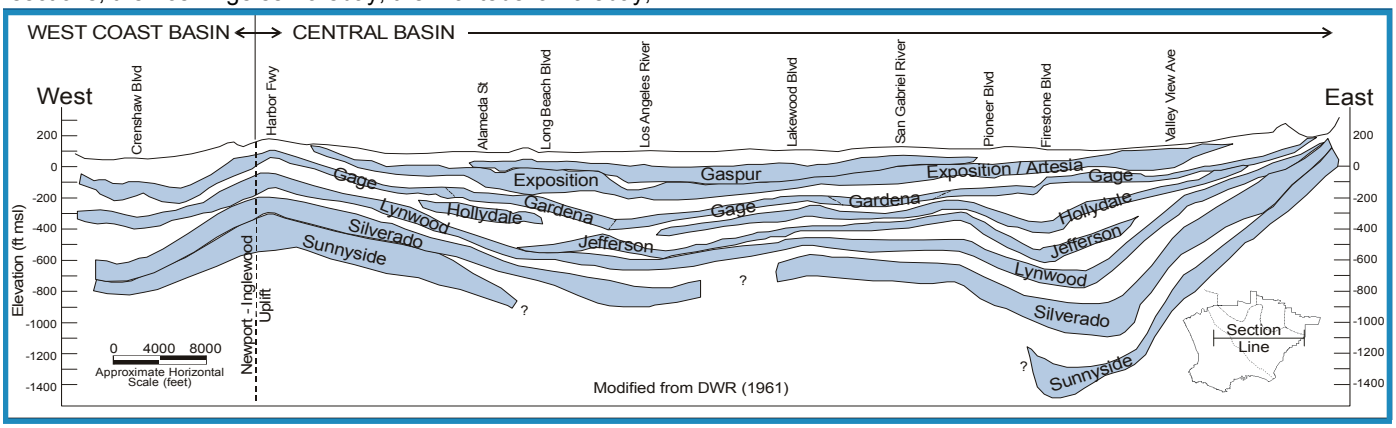

Figure 2—Generalized East / West Cross Section through the Central and West Coast Basins showing Aquifers

Groundwater Occurrence and Movement

Groundwater pumped from the CWCB currently provides approximately 36% of the total water supplies used by the overlying population of four million people in 43 cities of southern Los Angeles County.

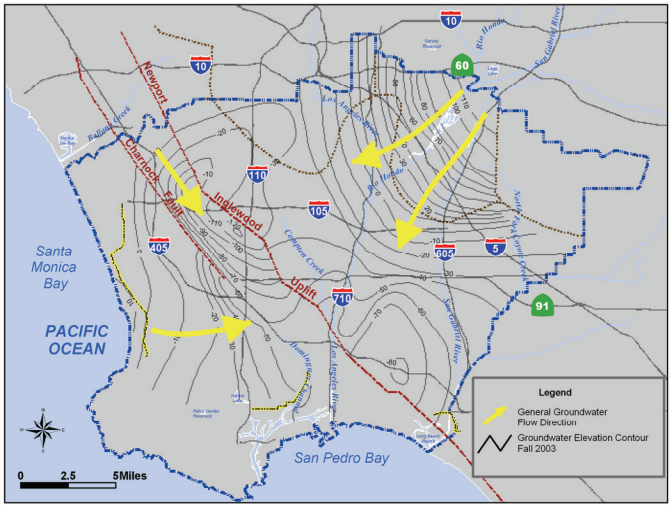

Figure 3—General Groundwater Flow Directions

Groundwater occurs in the pore spaces of the sediments in the basins. Where these sediments are thick and transmissive enough to supply sufficient quantities of water to wells for beneficial use, they are termed "aquifers." The name "aquitard" is given to the less permeable silt and clay layers that separate the aquifers. The major aquifers identified in the CWCB are shown on Figure 2 and include the following, from shallowest to deepest: **A)** the Gaspur and Semiperched aquifers of the Holocene Alluvium Formation; **B)** the Exposition, Artesia, Gage, and Gardena aquifers of the Upper Pleistocene Lakewood Formation; **C)** the Hollydale, Jefferson, Lynwood, and Silverado aquifers of the Lower Pleistocene Upper San Pedro Formation; and **D)** the Sunnyside Aquifer of the Lower Pleistocene Lower San Pedro Formation.

Aquifer depths can reach more than 2,000 feet in the CB and 1,500 feet in the WCB, although production wells generally do not need to be drilled this deep to find sufficient amounts of water. The general direction of groundwater flow in the CB is to the south and southwest away from the Montebello Forebay spreading grounds where significant recharge occurs, and to the east and southeast in the WCB away from the West Coast Basin Barrier Project or between the fault zones (Figure 3). Both the NIU and the Charnock Fault are partial barriers to groundwater flow, causing differences in water levels on opposite sides of each fault system.

Most of the groundwater in the CWCB remains at an elevation below sea level due to historic over pumping, so the importance of maintaining the seawater barrier injection wells to keep out the intruding seawater is critical.

The Groundwater Budget

Based on recent modeling of the CWCB by the U.S. Geological Survey (2003), an average groundwater budget was developed for the 30-year base period between water years 1970/71 and 1999/00 (Table 1). This budget shows the average annual inflows (recharge) and outflows (discharge) to the basins in acre-feet per year. Natural inflows come from the capture and infiltration of precipitation and storm water, whereas artificial inflows come from imported and recycled water purchased by WRD. The major areas for inflow include the Rio Hondo and San Gabriel River spreading grounds in the Montebello Forebay, the seawater barrier injection wells along the coast, areal recharge from precipitation falling on the basin floor and hillside runoff, groundwater underflow from adjacent basins, and seawater intrusion in certain areas. The major outflow is from wells that pump approximately 250,000 acre-feet per year from the CWCB. Over 550 groundwater pumping wells are located throughout both basins.

This average water budget provides a very useful picture of the long-term groundwater ins and outs to the CWCB. Actual annual values, however, may vary quite a bit from the long term average, and as the hydrological and cultural factors change in the CWCB, the long term water balance will also change. WRD will continue to track the hydrogeology of the basins and update the groundwater balance as necessary.

	CENTRAL BASIN	WEST COAST BASIN	TOTAL
Inflow			
Spreading - Stormflow	48,825	0	48,825
Spreading - Imported	39,305	0	39,305
Spreading - Recycled	34,770	0	34,770
Areal Recharge	32,300	15,600	47,900
Barrier Injection	5,300	29,300	34,600
Net Underflow	44,680	3,800	48,480
Seawater Intrusion	0	7,100	7,100
Total	205,180	55,800	260,980
Outflow			
Pumping	197,500	53,090	250,590
Net (Inflow - Outflow)	7,680	2,710	10,390

Table 1—Average Annual Water Balance 1970/71—1999/00 (afy)

For more information on any of the topics covered by this Technical Bulletin, please contact the author at the Water Replenishment District of Southern California.

Sources of Information for this Technical Bulletin:

Water Replenishment District of Southern California, 2004, "Engineering Survey and Report, 2004".

United States Department of the Interior, U.S. Geological Survey, 2003, "Geohydrology, Geochemistry, and Ground-Water Simulation-Optimization of the Central and West Coast Basins, Los Angeles County, California"; Water Resources Investigations Report 03-4065.

State of California Department of Water Resources, Southern District, 1961, "Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County - Appendix A - Ground Water Geology", Bulletin 104.

WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

12621 E. 166th Street, Cerritos, California 90703

Ph: (562) 921-5521, Fax: (562) 921-6101

www.wrd.org