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Pajaro Valley Water Management Agency

Geohydrology of Recharge and Seawater Intrusion in the Pajaro Valley, Santa Cruz and Monterey Counties, California

The U.S. Geological Survey (USGS) in cooperation with the Pajaro Valley Water Management Agency (PVWMA), has completed the collection and analyses of geologic, hydrologic, geophysical, and geochemical data in the coastal aquifer systems of the Pajaro Valley (fig. 1). These data were collected to delineate the geohydrologic framework of seawater intrusion, as well as, the source, age, and movement of ground water in the coastal aquifer systems (Hanson, 2003).

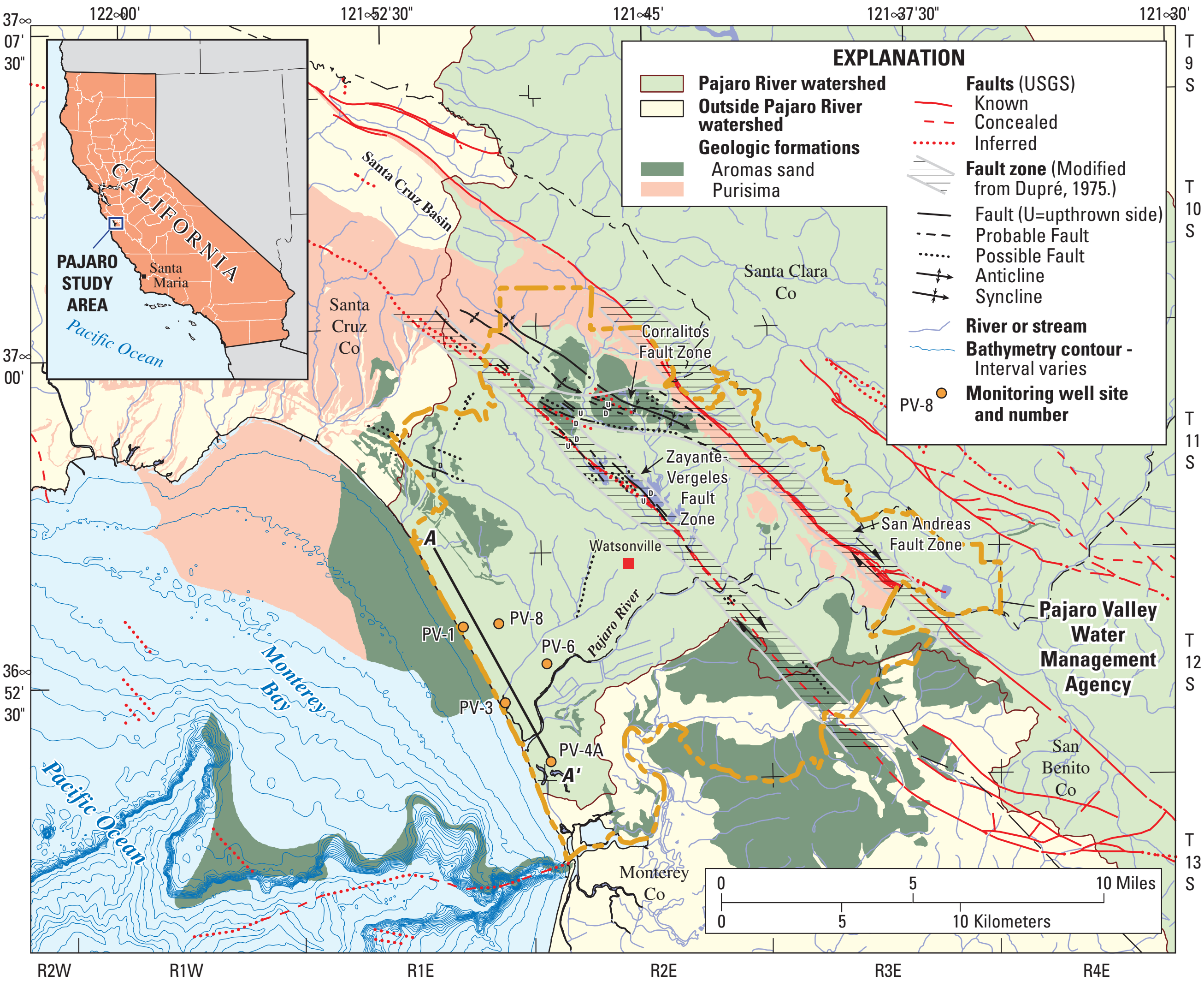


Figure 1. *Location of Pajaro Valley Water Management Agency, Santa Cruz and Monterey Counties, California.*

GEOLOGY

(1) Geophysical logs indicate confining beds that occur within older alluvium and in the upper and lower Aromas Sands (fig. 2).

(2) The layered terrestrial and marine deposits restrict seawater intrusion to zones of coarse-grained deposits (fig. 2).

HYDROLOGY

(1) Pajaro River streamflow and local runoff are the two sources of surface water available for ground-water recharge or additional water supply.

(2) Long-term water-level declines, climatic cycles of 2 to 19 years, and seasonal pumping all suppress water levels below seawater pressures and cause the landward flow of seawater (seawater intrusion) (fig. 3).

(3) The Pajaro River (Group 6) and local runoff (Group 7) (fig. 4) provide natural recharge to the ground-water flow system.

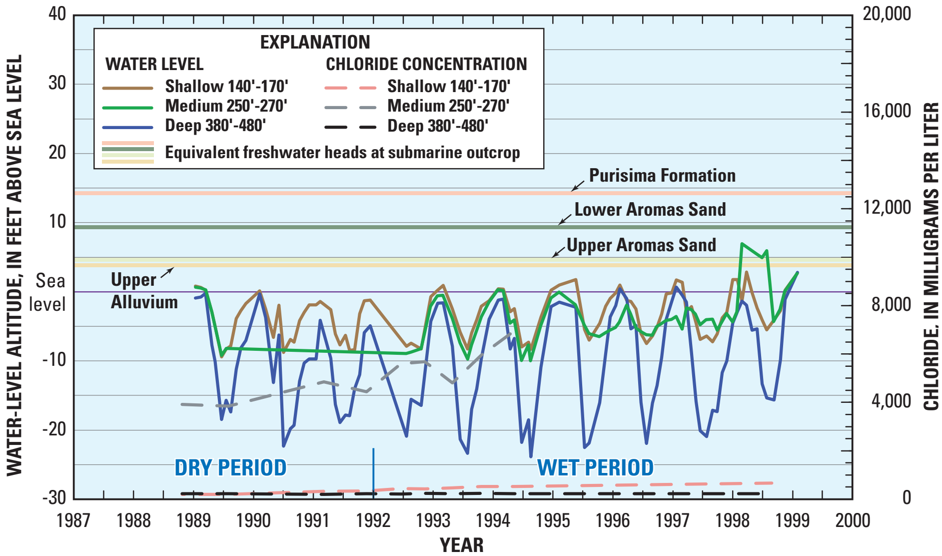
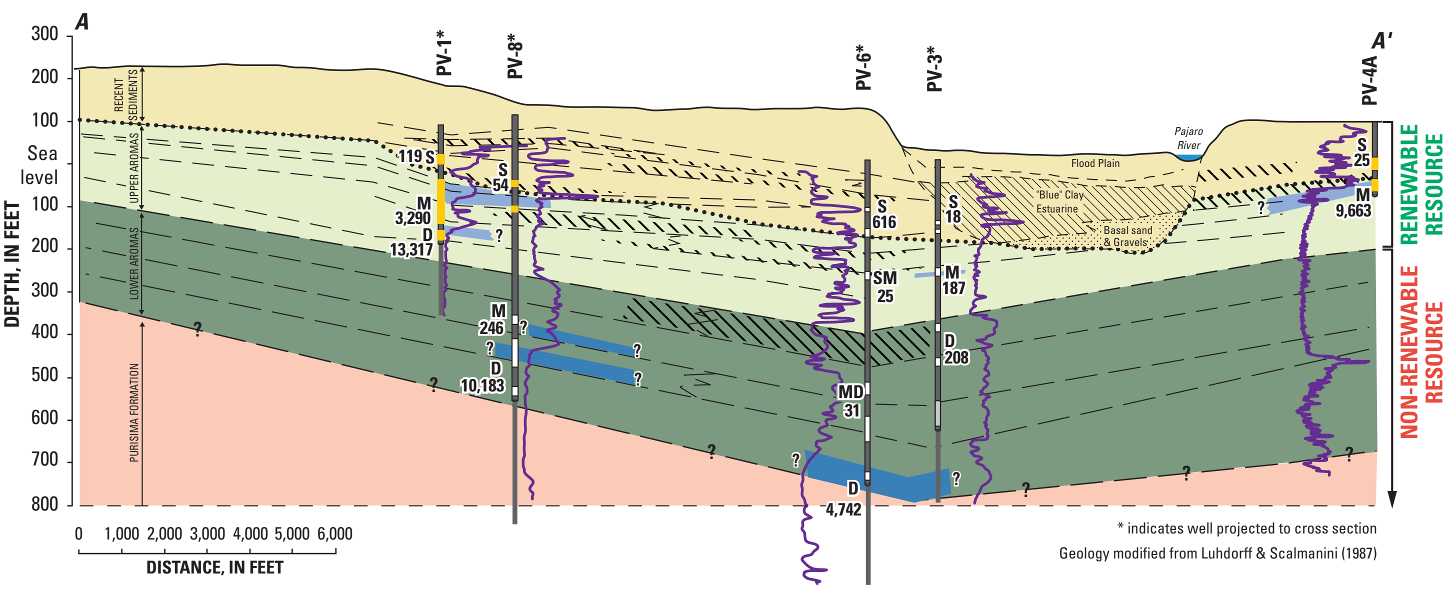


Figure 3. Water-level altitudes and chloride concentrations in well PV-3, Pajaro River watershed, Santa Cruz and Monterey Counties, California.

GEOCHEMISTRY

(1) Samples from coastal monitoring wells represent 5 groups of ground-water that differ from surface waters (groups 6 and 7) (fig. 4): (1) Recent fresh ground water; (2) Older fresh ground water; (3) Recent seawater intrusion; (4) Older sea water; and (5) Very old ground water.

(2) Stable isotopes indicate a mixture of older ground water and surface water in samples from coastal monitoring wells (Groups 1 and 2) in the upper-aquifer system (fig. 5).



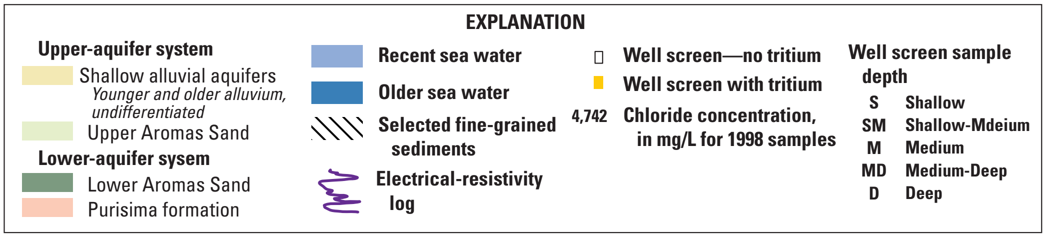


Figure 2. Cross section of the coastal aquifers showing seawater intrusion, chloride values in wells, perforated depths and generalized geology, Pajaro River watershed, Santa Cruz and Monterey Counties, California.

GEOHYDROLOGIC FRAMEWORK

(1) Shallow wells are pumping water from the upper-aquifer system that consists of recently recharged shallow ground water. This water is a renewable resource as indicated by the presence of tritium (fig. 2) and younger carbon-14 ages (table 1).

(2) Deeper wells are pumping water from the lower-aquifer system that consists of older ground water that was recharged thousands of years ago and may represent a nonrenewable resource in the coastal region .

(3) Alternating layers of fine-grained and coarse-grained sediments retard the vertical movement of recharge and result in water-level differences that have persisted for many years (fig. 3).

(4) The primary structures of the aquifers includes a fault-bounded region adjacent to the Santa Cruz Mountains between the San Andreas and Zayante-Vergeles fault zones (Dupre, 1975) (fig. 1). The relation of faults such as the Corralitos fault and Zayante Faults and ground- water flow remains uncertain (fig. 1).

SEAWATER INTRUSION

(1) Two types of saline water occur within the aquifers of the Pajaro Valley—recent and older seawater.

(2) Recent seawater intrusion contains tritium (<50 years old) and is present in basal layers of coarse-grained sediments of the recent and older alluvium and within the upper Aromas Sands (figs.2, 4, and 6). The stable isotope signature of water from wells in the Pajaro Valley with seawater intrusion differs from that in the adjacent Salinas Valley (fig. 5).

(3) Recent seawater intrusion at PV-1 was estimated to be as large as 60 percent of total seawater on the basis of chloride and stable-isotope

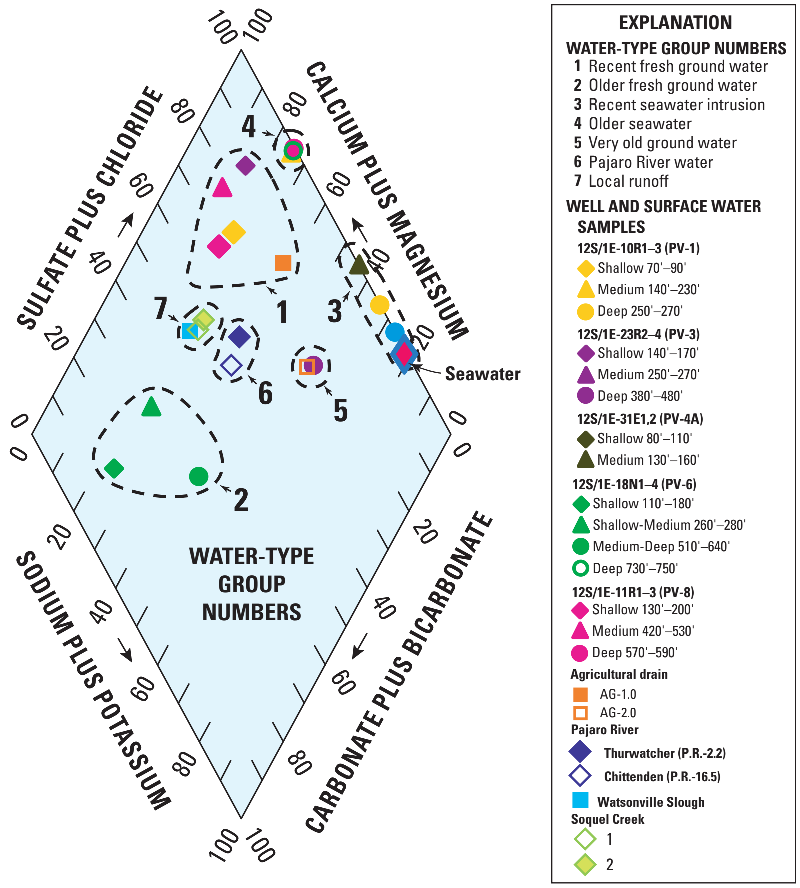


Figure 4. *Chemical evaluation of water from wells and surface sites in the Pajaro River watershed, Santa Cruz and Monterey Counties, California.*

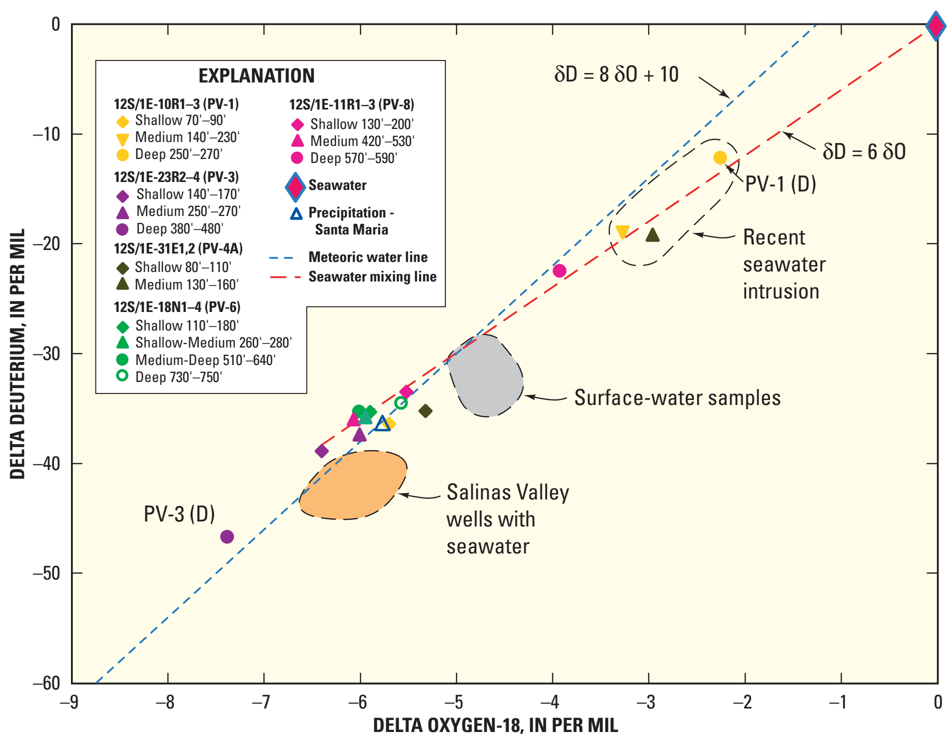


Figure 5. *Isotope values for selected wells and surface water sites in the Pajaro River watershed, Santa Cruz and Monterey Counties, California.*

mixtures (table 1, fig. 5). The vertical extent of seawater intrusion has increased at PV-1 between 1988 and 1998 (fig. 6).

(4) Older seawater in the lower Aromas Sand (figs. 2 and 4) is saline ground water that is not recent seawater intrusion.

SOURCE, AGE, AND MOVEMENT

(1) Ground-water from shallow monitoring wells is generally less than 50 years old. These waters are chemically (fig. 4) and isotopically (fig. 5) similar to local surface waters and represent the renewable resource.

(2) Ground-water from deep monitoring wells have uncorrected ages from 1,000 to 24,900 years old (table 1), were recharged thousands of years ago and represent the nonrenewable resource in the coastal region. Corrected carbon-14 ages (not shown) can be as much as 100 percent younger due to the addition of inorganic carbon to ground water (Davis and Bentley, 1982). These waters are chemically and isotopically different from local surface waters and may have been recharged during a period with a colder climate.

– R. T. Hanson

Table 1. *Selected water-chemistry constituents sampled from August 1998 through May 1999 for selected coastal monitoring wells, Pajaro Valley, California.*

Local Well Number (Screened interval, in feet below land surface)	Chloride Concentration (mg/L)	Total Dissolved Solids (mg/L)	Delta-oxygen-18 (per mil)	Delta-deuterium (per mil)	Tritium (pCi/L)	Uncorrrected Carbon-14 Age (years before present)
PV-1 (S) (70–90)	120	650	-5.7	-36.4	18.08	<50
PV-1 (M) (140–230)	9,500	20,300	-3.27	-18.7	6.304	2,200
PV-1 (D) (250–270)	13,317	24,900	-2.25	-12.2	5.09	1,000
PV-3 (S) (140–170)	616	1,490	-6.4	-38.9	0.3	7,000
PV-3 (M) (250–270)	187	583	-6.01	-37.4	0.416	5,900
PV-3 (D) (380–480)	209	594	-7.38	-46.7	0.3	24,900
PV-4A (S) (80–110)	No Data	No Data	-5.32	-35.23	8.16	1,100
PV-4A (M) (130–160)	9,663	18,240	-2.96	-19.17	9.376	2,300
PV-6 (S) (110–180)	18	372	-5.9	-35.3	0.3	5,500
PV-6 (SM) (260–280)	25	291	-5.96	-35.8	0.3	6,100
PV-6 (MD) (510–640)	31	313	-6.01	-35.3	0.3	8,600
PV-6 (D) (730–750)	4,742	8,360	-5.57	-34.53	0.3	11,800
PV-8 (S) (130–200)	54	687	-5.52	-33.5	14.24	<50
PV-8 (M) (420–530)	246	575	-6.07	-36.	0.3	6,500
PV-8 (D) (570–590)	10,183	20,580	-3.92	-22.5	0.3	8,100

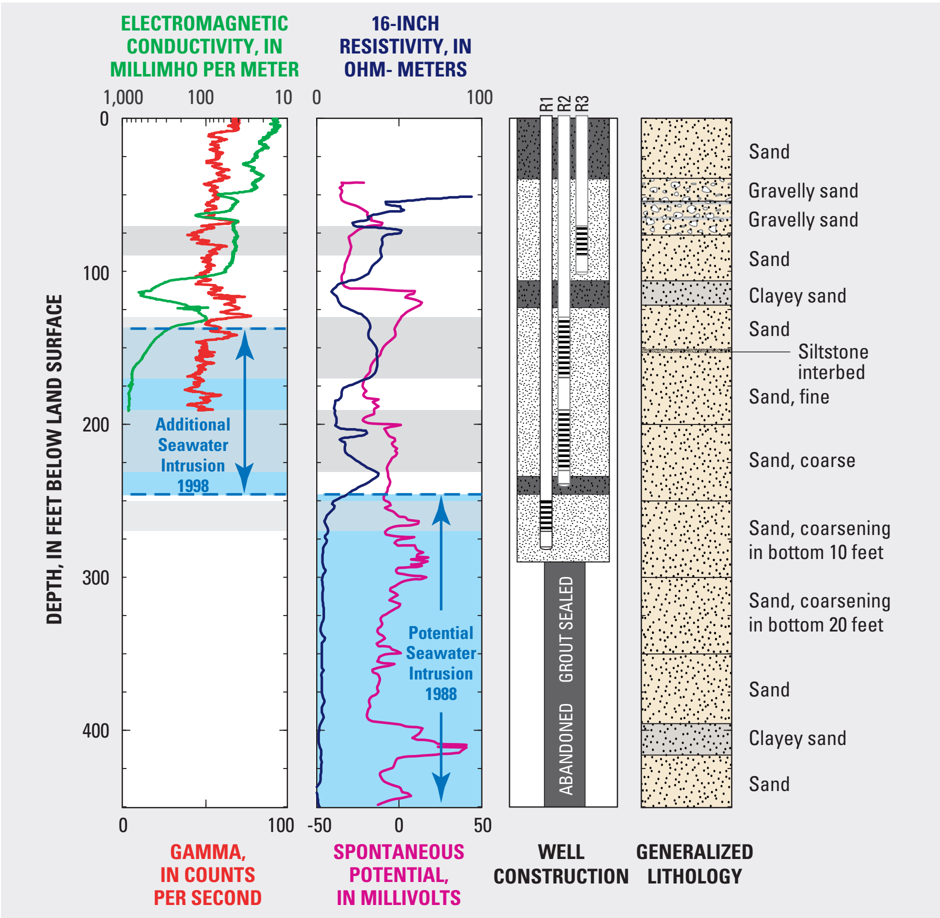


Figure 6. *Geophysical logs, well construction, and lithology for monitoring well PV-1, Pajaro Valley, Santa Cruz County, California.*

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