

HW-2B: CHARACTERIZING RESERVOIR PRESSURE

($u_d > 0$)

Effect of Displacement Pressure (u_d) on FWL vs OWC

ANSWER:

From sea level to sea floor, the hydrostatic and overburden gradient are the same (0.465 psi/ft). Below sea floor (1,350 ft BSL), the overburden gradient assumes a value of (0.93 psi/ft).

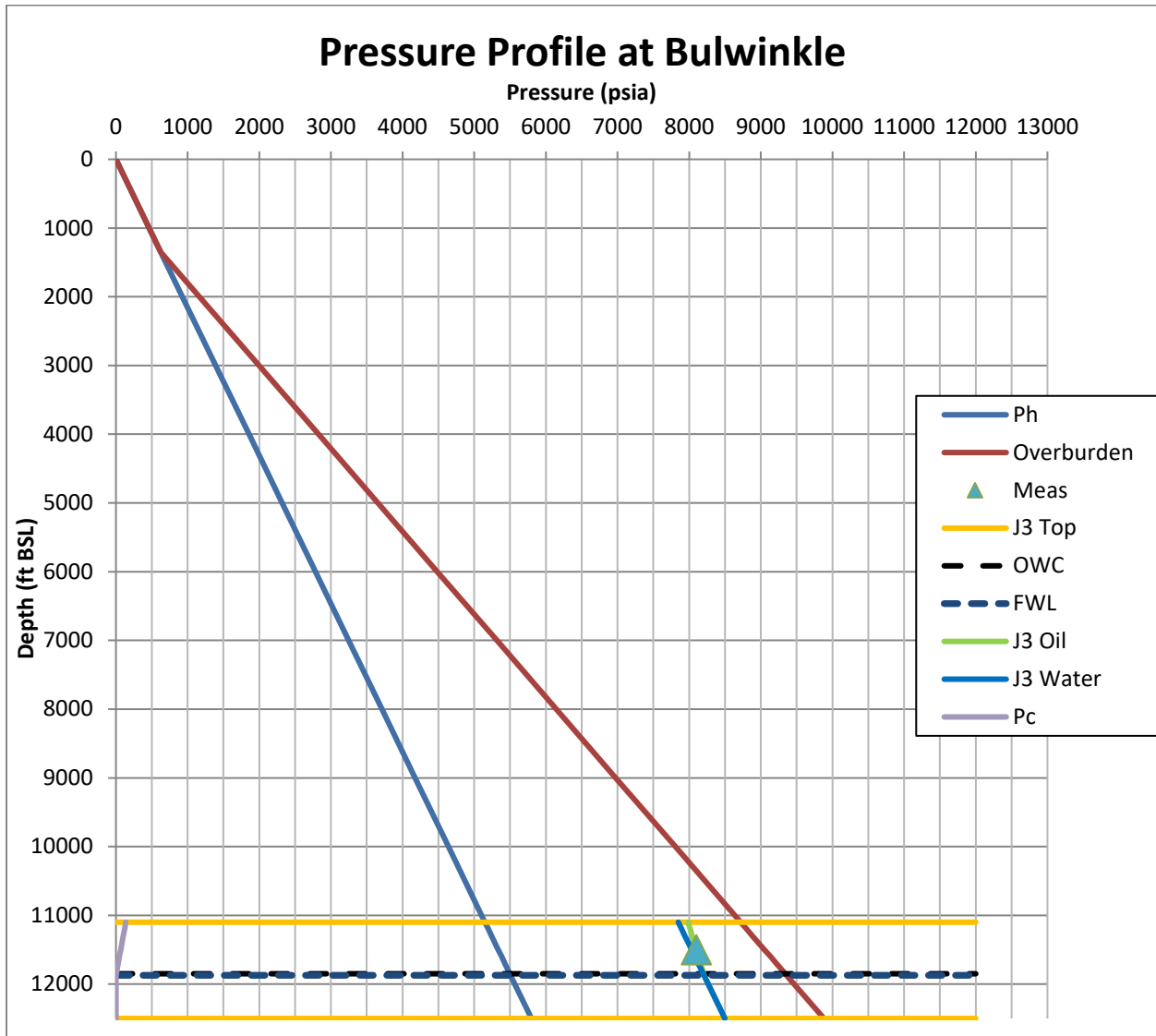


Figure A1: Pressure profiles at Bullwinkle from sea level through the J3 sand.

Pressure is measured in the oil leg of the J3 reservoir (above the OWC). We therefore project the oil pressure along the oil gradient upward to the crest of the structure and downward to the oil-water contact (green line), (Figure A3).

We now interpret Figure 3 to determine the displacement capillary pressure (u_d). We interpret $u_d \approx 14$ psi.

Since $u_c = u_o - u_w$, we now can calculate the water pressure at the oil-water contact because we know the capillary pressure at this depth equals 14 psi (u_d).

The non-graphical solution to find the depth of the FWL relative to the oil-water contact is as follows:

$$u_c|_{\text{datum}} = (\rho_w g - \rho_o g) * \Delta h \quad [1]$$

Where

u_c = Value of u_c at the oil water contact (14psi at 11,850 ft BSL) (psi)

$\rho_w g$ = Water Gradient (psi/ft)

$\rho_o g$ = Oil Gradient (psi/ft)

Δh = Elevation of datum above FWL (positive values indicate FWL is deeper than datum)
(ft)

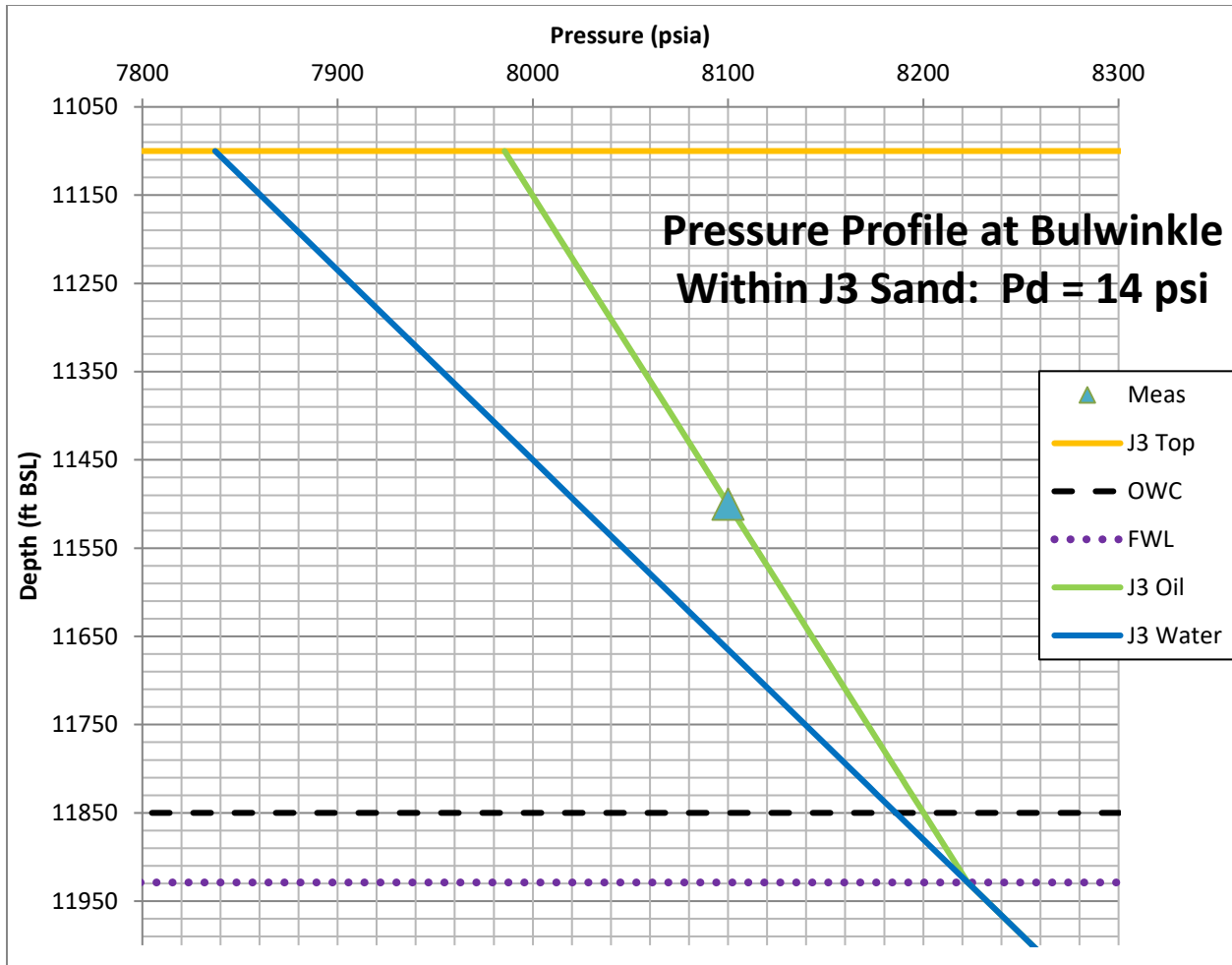


Figure A3: OWC is at 11,850, and the FWL is at 11,928.9 ft BSL. At the OWC, $ud \approx 14$ psi, which corresponds to an OWC elevation of ~ 79 ft above the FWL ($S_w = 100\%$ and $u_c = 0$).

Table A2: Answers to Table 1- Question 3.

High Displacement Pressure Scenario			
Capillary Pressure at OWC (psia)	~14		
FWL Depth (ft BSL)	11,928.9		
	<u>Oil</u>	<u>Water</u>	<u>Capillary (ucow)</u>
Pressures at Top of J3 Sand (psia)	7,985.5	7,8373.3	148.2
Aquifer Excess Pressure (psia)	2,675.8		

Aquifer Excess Pressure = $u_{\text{aquifer}} - u_h = 2,675.8$ psia. We identify this value by looking at the separation between the hydrostatic pressure and the J3 water pressure.