LINDBERG GEOLOGIC CONSULTING
David N. Lindberg, CEG
Post Office Box 306
Cutten California 95534
(707) 442-6000

September 8, 2022 0448.01

Mr. Steven Santos, Senior Planner
Humboldt County Planning and Building Department
3015 H Street
Eureka, CA 95501

Subject: Supplemental Narrative, Dyerville Farms Hydrologic Isolation of Existing Well
28525 Dyerville Loop Road, Garberville, APN: 216-144-017, DWR WCR2020-007610

Dear Mr. Santos:

Please note that this letter is provided on behalf of our client, as a courtesy to the Humboldt County Board of Supervisors to aid in their understanding and is not a professional service provided to the County. In response to your request for additional narrative, we have prepared this letter. It is unfortunate that we transposed two digits in the well elevation, of our May 3rd report about this well. To clarify, well elevation is 3,640 feet rather than 3,460 feet, as originally cited. We apologize for this typographic error. Our conclusion that the well is hydrologically isolated did not change because of correcting the well elevation.

As measured from the Humboldt County WebGIS, this well is more than 1,700 feet from the head of the Dean Creek tributary. It has been our understanding that the focus is on the area within a 1,000-foot radius of a well, is this my misconception? Within a 1,000-foot radius is an area of over 3.1 million square feet (72 ac). Published precipitation and recharge information shows recharge rates in northwestern California are approximately 33 percent of precipitation (Flint et al., 2013). The USDA-NRCS Web Soil Survey assigns 49 to 90 inches of annual precipitation to this location. Using the lower precipitation estimate, and the USGS regional recharge rate (49 in/yr. x 0.33% = 16.17 in/yr. = 1.35 ft), we estimate that approximately 97 acre-feet, or nearly 32 million gallons per year of recharge will occur *within the 1,000-foot radius* of this well. Extended to the entire 183-acre parcel, that equals more than 245 acre-feet of recharge.

The bottom of well 2020-007610 was drilled 90 feet deeper than the mapped head of the nearest Dean Creek tributary on the County WebGIS. However, well 2020-007610 is only screened to the 300-foot depth, making the effective bottom of the well 70 feet (rather than 90 feet) lower in elevation than the mapped head of the Dean Creek tributary, more than 1,700 feet south-southwest of the well.

Our visualization of the subsurface hydrogeology includes multiple aquifers; a near-surface or shallow unconfined aquifer, potentially some perched aquifers, and a deep, confined, (or semiconfined) aquifer from which this well draws its water. In our visualization, the uppermost near-surface shallow unconfined aquifer provides the water to the tributaries of Dean and Steelhead Creeks, while the Dyerville Farms well draws from an interval between 160 to 300 feet in the deep, confined, or semiconfined aquifer. The well is sealed through the first 20 feet; this isolates it from near surface unconfined aquifer(s) adjacent to the well bore.

The shallow unconfined aquifer may be visualized as mimicking topography in the shallow subsurface. Flow paths in the shallow unconfined aquifer are understood to be downslope perpendicular to contour, unlike confined aquifers where flow may be influenced by fractures, bedding attitudes, foliation orientation, and other anisotropies in the body of the rock formation. In our visualization, the Dyerville Farms well draws from a deep confined aquifer in greenstone, whereas Dean Creek flows on mélange, a different rock type.

There are swales and a side hill ridge between the Dyerville Farms well and the head of the nearest Dean Creek tributary, which will strongly influence flow directions in the near surface unconfined aquifer. Well 2020-007610 is drilled in a different rock unit (greenstone, gs) than the mélange (cm1) which underlies the head of the Dean Creek and Steelhead Creek tributaries. Another rock unit underlies Pratt Mountain (metasandstone? yb). Without getting too technical, this well is drilled in greenstone, Dean Creek is mapped in mélange, and adjacent Pratt Mountain is composed of metasandstone. Plunge of foliation in the greenstone is to the northeast, away from the Dean Creek drainage. Dip of bedding and foliation is westerly in the metasandstone. Bedding is not preserved in the mélange. Anisotropies such as dip of bedding and plunge of foliation can have a strong influence on groundwater flow paths in the subsurface. Further, groundwater flow between these disparate rock units can be limited due to tectonic movements resulting in the shearing and “smearing” of the contacts between rock bodies over time.

When a well is pumped, water in the bore is drawn up first. As the water level in the well drops, water begins flowing into the bore from the upper parts of the aquifer. If pumping continues at a rate faster than water refills the bore, a cone of depression forms in the aquifer surrounding the well bore. Depending on the pump rate and the ability of the formation to refill the bore, this cone can become wider as the well is pumped. For the cone to intercept topography at the mapped head of the Dean Creek tributary, the cone of depression would necessarily become very wide and flat, with a radius of more than 1,700 feet. If this unlikely event is even physically possible, it would require an extended period of continuous pumping. As the cone of depression becomes wider, the contribution from any point on the circumference decreases as a function of the square of the distance from the well. The inverse square law dictates that only a small fraction of groundwater will come from any given point on the 10,600-foot plus circumference of the 1,700-foot radius cone.

Please contact our office if you have any questions or concerns.

Sincerely,

David N. Lindberg, CEG 1895
Lindberg Geologic Consulting

DNL:sll

Flint et al.: Fine-scale hydrologic modeling for regional landscape applications: the California Basin Characterization Model development and performance. Ecological Processes 2013 2:25.