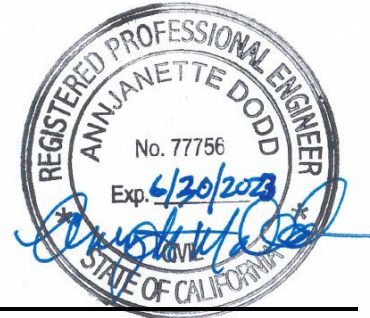




## TECHNICAL MEMORANDUM

To: Humboldt County Planning Department  
 From: Annjanette Dodd, PhD, CA PE #77756 Exp. 6/30/2023  
 Date: March 24, 2023  
 Subject: Groundwater Well Evaluation – ECD Holdings Inc.  
 2260 Hooven Rd., McKinleyville, CA 95519 (APN: 511-141-015)



### BACKGROUND AND PURPOSE

ECD Holdings, Inc. is proposing to permit commercial cannabis cultivation activities in accordance with the County of Humboldt's (County) Commercial Cannabis Land Use Ordinance (CCLUO), aka "Ordinance 2.0". The project requires a Conditional Use Permit to expand the current mixed light cannabis cultivation from 10,000 sq. ft. to 43,560 sq. ft.

The proposed irrigation water source would replace an existing surface water diversion with a combination of reclaimed water from dehumidification and air conditioning (A/C) units, rainwater collection, and an existing groundwater well. With the approval of the proposed cultivation expansion, the existing, permitted surface water diversion of 120,000 gallons per year for cannabis use would cease.

Since the project proposes the use of a well for irrigation, the County of Humboldt Planning and Building Department, in a letter to the applicant dated August 10, 2022, requested the applicant submit a hydrogeologic analysis. The purpose of the analysis is to determine whether use of the well would have a significant impact on the surrounding area.

The purpose of this Technical Memorandum (TM) is to provide an assessment to evaluate the potential impacts associated with the use of the existing well, in combination with reclaimed water and rainwater collection, for irrigation of the proposed cannabis project.

### PROJECT LOCATION AND SITE INFORMATION

The project is located at 2260 Hooven Rd., McKinleyville, CA 95519 (APN: 511-141-015) within the McKinleyville Community Planning Area (CPA).

The well is located within the Norton Creek watershed, a tributary to the Mad River which flows into the Pacific Ocean approximately 2-miles to the west of the project site. The Norton Creek watershed is within the California Department of Water Resources (DWR) Bulletin 118 Mad River Groundwater Basin – Dows Prairie Subbasin (Basin Number 1-8.02) referred to herein as the Dows Prairie Subbasin (DWR, 2004 – Attachment 1).

The subject property has historically been used for residential, agricultural, and cannabis cultivation.



Existing buildings include a residence, two (2) two-story buildings, 10,000 sq. ft. of mixed light cultivation greenhouses, on-site ancillary nursery greenhouse, a 90,000-gallon water tank, and four (4) 5,000-gallon water tanks. Existing permitted cultivation activities include 4,400 sq. ft. of indoor cultivation, 10,000 sq. ft. of mixed light cultivation, and an ancillary nursery (ECD Holdings, Inc. Cultivation and Operations Manual and Development Plans, 2023).

**EXISTING AND PROPOSED WATER DEMAND**

The existing cultivation operation has an annual irrigation use of 120,000 gallons (ECD Holdings, Inc. Cultivation and Operations Manual, 2023) and is sourced from an authorized, existing, onsite surface water diversion. The existing diversion is an approved water source for the existing cultivation and has a Small Irrigation Use Registration (SIUR). The proposed project would cease use of this diversion for irrigation upon approval of the expansion. The proposed expansion would increase annual cultivation water use to 610,000 gallons (14 gallons/sf), for an increase of 490,000 gallons compared to existing demand (Table 1).

*Table 1: Estimated irrigation water use.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Irrigation (1,000 gallons)	35	35	40	40	60	60	75	75	60	60	35	35	<b>610</b>

**WATER STORAGE**

The existing onsite irrigation water storage infrastructure is comprised of a permitted 90,000-gallon metal tank and four (4) 5,000-gallon tanks, for a total storage capacity of 110,000 gallons.

**WATER SUPPLY PLAN**

The proposed irrigation water source is a combination of reclaimed water from the dehumidification and air conditioning (A/C) units, rainwater collection, and an existing groundwater well (ECD Holdings, Inc. Cultivation and Operations Manual, 2023).

**Reclaimed Water**

The dehumidifier units and A/C units will serve a dual purpose of climate control and capturing condensed water. Condensed water will be plumbed to the irrigation water storage tanks to be reclaimed and reused for irrigation.

The applicant proposes to use eight (8) 5000W Anden 710 high-efficiency dehumidifier units and four (4) A/C units for indoor cultivation and eight (8) 5000W Anden 710 high-efficiency dehumidifier units for mixed light cultivation. All dehumidifier and A/C units would be operated year-round. Each dehumidifier has a maximum recapture rate of approximately 710 pints (88.75 gallons) per day. Each A/C unit has the potential to capture up to 12.5 gallons of water per day. For conservativeness, a capture efficiency of 60% was assumed (ECD Holdings, Inc. Cultivation and Operations Manual, 2023). Thus, the dehumidifiers and A/C units have the potential to reclaim approximately 321,930 gallons of water annually to reuse for irrigation.

**Rainwater Collection**

The potential rainwater collection volume was estimated based on the rainwater catchment surface area (existing and proposed buildings) and historic rainfall data. Historic rainfall data was sourced from PRISM



Climate Group (<https://prism.oregonstate.edu/explorer/>). The PRISM Climate Group gathers climate observations from a wide range of monitoring networks and provides time series values of precipitation for individual locations based on topography and historic precipitation values from 1985 through 2021. Using annual rainfall from 2000-2021, which is less than the average over the period of record, the average rainfall for the project area is 49.5 inches. The lowest rainfall year was 2013 and totaled 24.2 inches. The total annual rainfall over the 16-acre project parcel is 10.5 and 21.5 million gallons during the lowest and average rainfall years, respectively.

Roof areas on which rainwater catchment is proposed to be implemented are summarized in Table 2. It was assumed that 50% of the proposed greenhouse surface area would be the effective catchment area and the existing buildings would provide the remaining catchment area. The low annual rainfall is the lowest rainfall year in the PRISM record in the vicinity of the site and represents the dry year.

The average monthly rainfall distribution was obtained from PRISM and used to distribute the annual rainfall for an average year and a dry year. The rainfall distribution along with the potential rainwater collection volume and estimated actual rainwater collection volume are illustrated in Figure 1 and Figure 2. It is assumed that the actual rainwater collection efficiency is 85% of the potential rainwater volume. Using an efficiency of 85%, the total annual rainwater collection during an average year and a dry year are 720,503 gallons and 352,249 gallons, respectively.

*Table 2: Estimated rainwater catchment area and potential collection volumes during average and dry rainfall years.*

Catchment Surface	Roof Area (sq. ft.)	Catchment Area (sq. ft.)	Average Annual Rainfall (in)	Low Rainfall Year (in)	Potential Rainwater Collection Volume Average Year (gallons)*	Potential Rainwater Collection Volume Dry Year (gallons)*
<P>155.5'x280' Greenhouse	43,560	21,770	49.5	24.2	671,760	328,420
<E> 2,400 sf Building	2,400	2,400	49.5	24.2	74,060	36,210
<E> 50'x66' Building	3,300	3,300	49.5	24.2	101,830	49,780
<b>Total</b>		<b>27,470</b>			<b>847,650</b>	<b>414,410</b>

\*1-inch of rainfall over 27,470 sq. ft. produces 17,124 gallons; 85% of this is 14,555 gallons.

### **Well Water**

Well water would be used to offset reclaimed water and rainwater collection during the summer months when rainfall is low. The monthly water balance, using actual rainfall collection (Figure 1 and Figure 2), is summarized in Table 4 and Table 5, for an average and dry year, respectively. Approximately 127,300 gallons and 171,800 gallons of well water would be needed to offset reclaimed water and rainwater during an average and dry year, respectively, representing less than 30% of the overall irrigation demand annually (Table 3). The maximum daily pumping rate, to keep the tank storage full, is less than 3.1 gallons per minute (gpm) over an 8-hour pumping period, during daylight hours, as the pump is solar powered.

*Table 3: Irrigation demand (in percent) by water source.*

Source	Average Year	Dry Year
Reclaimed	53%	53%
Rainwater	26%	19%
Well Water	21%	28%



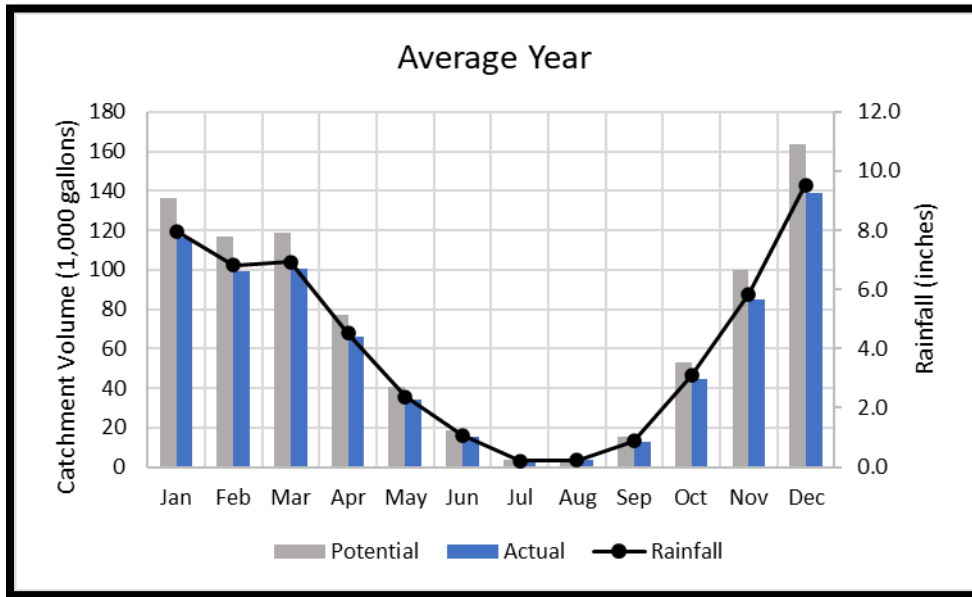


Figure 1. Rainfall distribution and rainwater catchment volume for an average year.

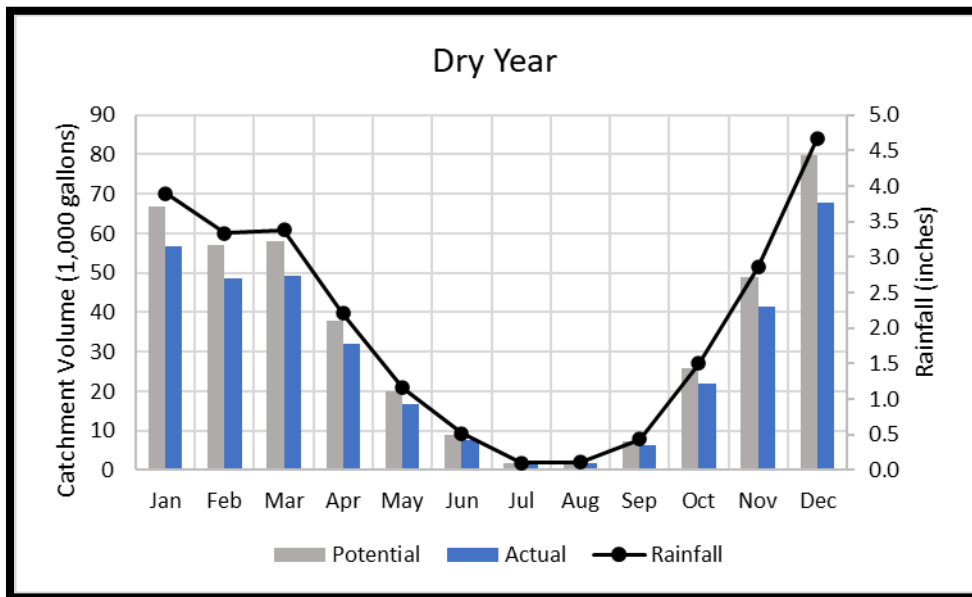


Figure 2. Rainfall distribution and rainwater catchment volume for a dry year.



**Table 4: Monthly water use and storage during an average year (1,000 gallons).**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
<b>Water in storage at beginning of month</b>	110	110	110	110	110	110	110	110	110	110	110	110	110	N/A
<b>Water demand for irrigation</b>	-35	-35	-40	-40	-60	-60	-75	-75	-60	-60	-35	-35	-35	-610
<b>Reclaimed water</b>	27.3	24.7	27.3	26.5	27.3	26.5	27.3	27.3	26.5	27.3	26.5	27.3	27.3	321.9
<b>Water needed to fill tank by end of month</b>	7.7	10.3	12.7	13.5	32.7	33.5	47.7	47.7	33.5	32.7	8.5	7.7	7.7	N/A
<b>Rainfall to storage</b>	7.7	10.3	12.7	13.5	32.7	15.6	3.1	3.4	13.0	32.7	8.5	7.7	7.7	160.7
<b>Storage at end of month (reclaimed water plus rainwater collection)</b>	110	110	110	110	110	92	65	66	89	110	110	110	110	N/A
<b>Well water to fill tank</b>	0	0	0	0	0	18	45	44	21	0	0	0	0	127.3
<b>Daily well pumping rate (gpm) - 8-hr daylight period</b>	0	0	0	0	0	1.2	3.0	3.0	1.4	0	0	0	0	N/A

**Table 5. Monthly water use and storage during an average year (1,000 gallons).**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Total
<b>Water in storage at beginning of month</b>	110	110	110	110	110	110	110	110	110	110	110	110	110	N/A
<b>Water demand for irrigation</b>	-35	-35	-40	-40	-60	-60	-75	-75	-60	-60	-35	-35	-35	-610
<b>Reclaimed water</b>	27.3	24.7	27.3	26.5	27.3	26.5	27.3	27.3	26.5	27.3	26.5	27.3	27.3	321.9
<b>Water needed to fill tank by end of month</b>	7.7	10.3	12.7	13.5	32.7	33.5	47.7	47.7	33.5	32.7	8.5	7.7	7.7	N/A
<b>Rainfall to storage</b>	7.7	10.3	12.7	13.5	16.9	7.6	1.5	1.7	6.3	21.9	8.5	7.7	7.7	116.3
<b>Storage at end of month (reclaimed water plus rainwater collection)</b>	110	110	110	110	94	84	64	64	83	99	110	110	110	N/A
<b>Well water to fill tank</b>	0	0	0	0	16	26	46	46	27	11	0	0	0	171.8
<b>Daily well pumping rate (gpm) - 8-hr daylight period</b>					1.1	1.8	3.1	3.1	1.9	0.7				N/A



## GROUNDWATER SOURCE WELL INFORMATION

The proposed well water source to augment reclaimed water and rainwater collection is an existing groundwater well (WCR2021-004045, Lat/Long: 40.967690, -124.084773, Attachment 2, Figure 3). The well was drilled to a depth of 400 feet BGS by Fisch Drilling on March 9<sup>th</sup>, 2021. The well geologic log within the well completion report (WCR) reported overburden surface soil, silt, clay, and organics from 0-28 ft below ground surface (BGS), shale clay from 28-34 ft BGS, various interbeds of brown silty clays, and sands from 34-389 ft BGS, shale clay from 389-393 ft BGS, and 'blue clay and Tree' (presumable organics) from 292-400 ft BGS. As per the WCR, the well was cased with a 5.563-inch (outer diameter) blank PVC casing from 0-100 ft BGS, and screened PVC casing from 100-400 ft BGS. Depth to first water was recorded as 16 ft BGS, a static water level of 260 ft BGS, and an estimated well yield of 15 gpm after a 4-hour air lift test. The existing well pump is a solar powered Grundfos 6SQF3 pump with a maximum capacity of 5.9 gpm.



Figure 3. Project well with mapped surface water features.

## GROUNDWATER BASIN

The project is located in the Mad River Groundwater Basin – Dows Prairie Subbasin (Basin Number 1-8.02, Attachment 1). The Dows Prairie Subbasin covers an area of 14,000 acres (21.9 square miles) and is bounded by Little River to the north, Mad River to the south, the Pacific Ocean to the west, and Franciscan Formation to the east (Figure 4). The Quaternary Hookton Formation is the water-bearing formation in



the subbasin and is comprised of clay, sand, and thin gravel beds. The formation is at least 150 feet thick and may be over 200 feet thick in other areas. The Hookton Formation is known to have moderately low permeability and supplies unconfined groundwater to the region. Recharge occurs by rainfall infiltration. DWR reports an estimated usable storage capacity of 10,500 acre-feet based on a saturated depth interval of 10- to 150-feet BGS, a surface area of 6,500 acres, and a specific yield of 11- to 12-percent. The Bulletin 118 basin description Groundwater Budget (Type B) was conducted in 1996 and estimated groundwater extraction for agricultural and municipal/industrial uses are 2,100 and 80 acre-feet, respectively, and deep percolation from applied water to be 500 acre-feet per year.

The Mad River Groundwater Basin has not been identified by the California Department of Water Resources (DWR) as a critically overdrafted basin. Critically overdrafted is defined by DWR as, "A basin subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts." In addition, as part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program, DWR created the CASGEM Groundwater Basin Prioritization statewide ranking system to prioritize California groundwater basins to identify, evaluate, and determine the need for additional groundwater level monitoring. California's groundwater basins were classified into one of four categories: high-, medium-, low-, or very low-priority. The Mad River Groundwater Basin was ranked as a very low priority basin by the CASGEM ranking system (DWR, 2021).

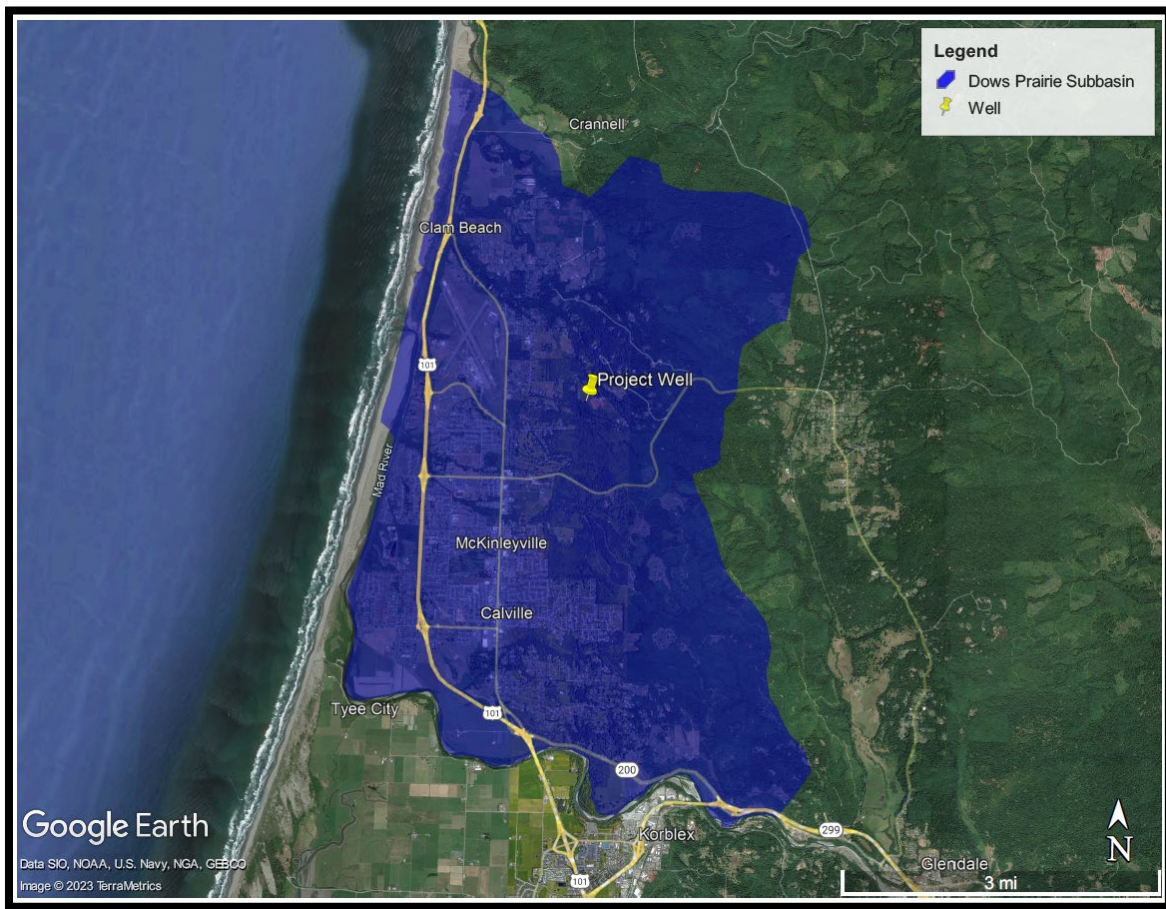


Figure 4. Dows Prairie Subbasin Groundwater Basin



## REGIONAL AND LOCAL GEOLOGY

The 30x60-minute Eureka Quadrangle geologic map (1:100,000 scale) mapped the project parcel on geologic units *Qm* and *QTw* (Figure 5). *Qm* is described as 'undeformed marine shoreline and aeolian deposits of the Holocene and Late-Pleistocene, consisting of gravels and sands and *QTw* is described as marine and nonmarine overlap deposits from the late Pleistocene to middle Miocene, comprised of thinly bedded to massive, weakly lithified siltstone, medium-grained sandstone, and locally soft, scaly mudstone (McLaughlin et al, 2000). The parcel is located within the Mad River Fault Zone (MRFZ) region, a northwest striking belt of en-echelon thrust faults and folds that dip predominantly northeast, approximately 80-km-long and 15- to 25-km wide (Carver and Burke, 1992). The project well is located near the contact of geologic units *Qm* and *QTw* (Figure 5). The WCR geologic log for the project's well is consistent with the geologic unit descriptions described by McLaughlin et al (2000).

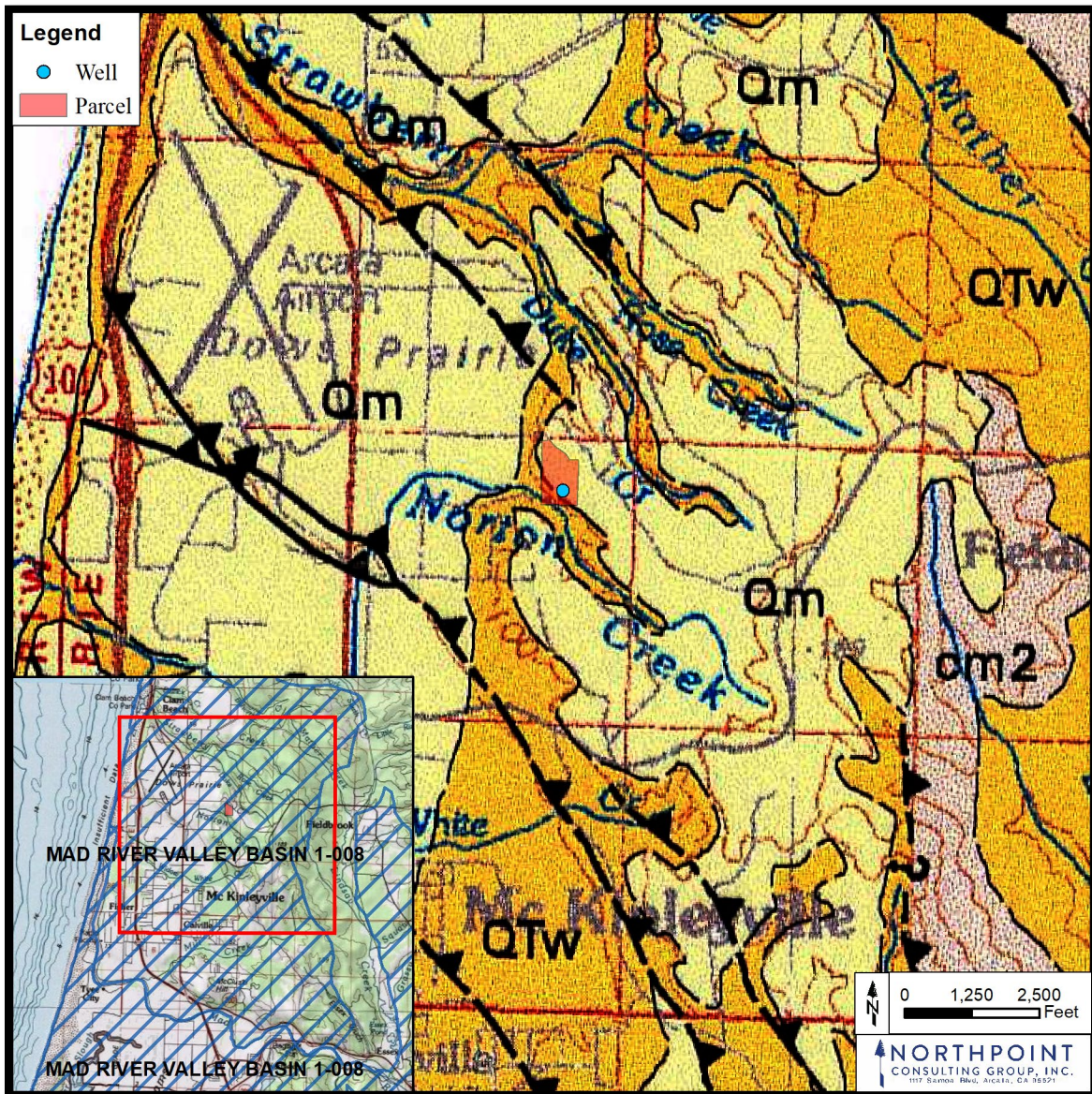


Figure 5. Geologic Map (inset identifies mapped area, source: McLaughlin et al, 2000).





## NEARBY SURFACE WATER AND GROUNDWATER

### Surface Water

A site visit was conducted on October 10, 2022 to identify surface water features near the project's well. There is a seep on the subject parcel, located approximately 150 feet southwest of the well (Lat/Long: 40.967315, -124.085177, Figure 3 and Figure 6). The nearest mapped surface waterbody is an unnamed tributary to Norton Creek, approximately 520 feet to the southwest. Flowing water was observed in this tributary and in Norton Creek on the day of the site visit.

The existing surface water diversion is located approximately 800 feet to the northeast (Figure 8). With the approval of the proposed cultivation expansion, surface water diversion for cannabis use would cease.

The seep occurs at an approximate elevation of 365 ft, as per the USGS 3DEP digital elevation model (DEM). The seep occurs at a hollow/channel head cut into *Qm* material and was discharging at approximately 1-3 gpm at the time of the site visit. The seep is located beneath a forested canopy comprised primarily of coastal conifer species. Surface water from the seep infiltrates directly into the ground within few feet towards the southwest, away from the well. Due to lack of scouring and surficial erosional features, there is no evidence of frequent or significant local surface water flow in the hollow due to the seep.

### Groundwater

No wells were identified by the WCR Map Application website within 1,000 ft of the project well. The project well is located with the Public Land System survey (PLSS) Section H07N01E29 and is one of 6 domestic wells in the Section on DWR's Well Completion Report (WCR) Map Application website (Figure 7). The nearby PLSS Sections, PLSS Sections H07N01E20, H07N01E21, and H07N01E28 have 26, 9, and 5 well completion reports, respectively. No wells were identified by the WCR Map Application website within 1,000 ft of the project well; the two closest wells are over 1,000 feet away (Figure 8). WCRs in the PLSS sections all had geologic logs reporting silty clay soil overlying interbeds of sand, clay, and gravel, often occurring between 20 and 400 ft BGS. Static water levels and well yields vary between wells, suggesting spatial heterogeneity in groundwater distribution and aquitard features. Well test yields reported 4 gpm–150 gpm, and two of the 18 WCRs within the immediate surrounding PLSS sections marked as dry holes. The spatial heterogeneity of well yields in the reviewed WCRs is not unusual in volcanic deposition, which can show marked differences in groundwater yields due to differences in the continuity of Coast Range geologic units and possible confining/aquitard layers, such as shale.



Figure 6. Picture of nearby seep.

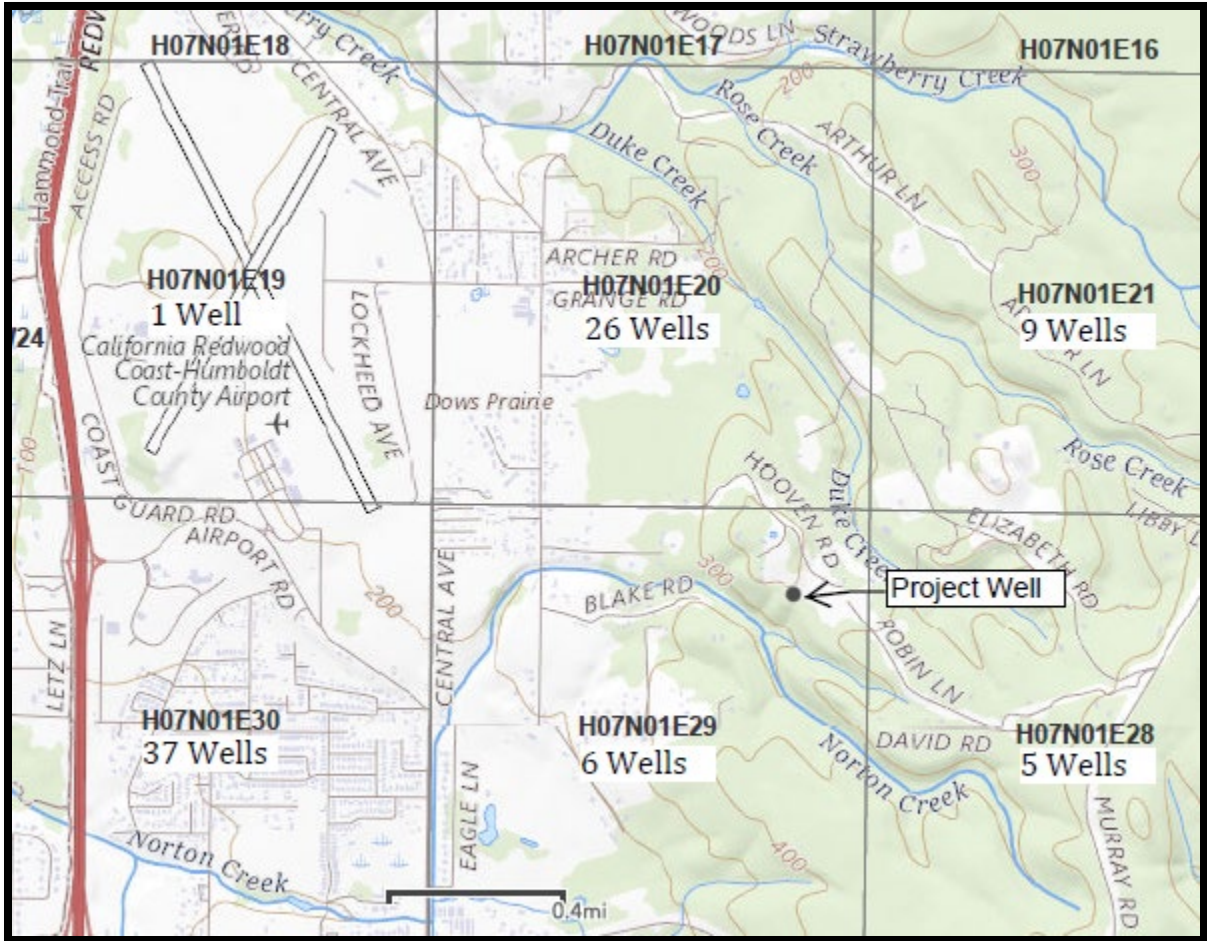


Figure 7. Department of Water Resources Well Completion Report Map Application nearby domestic well counts.



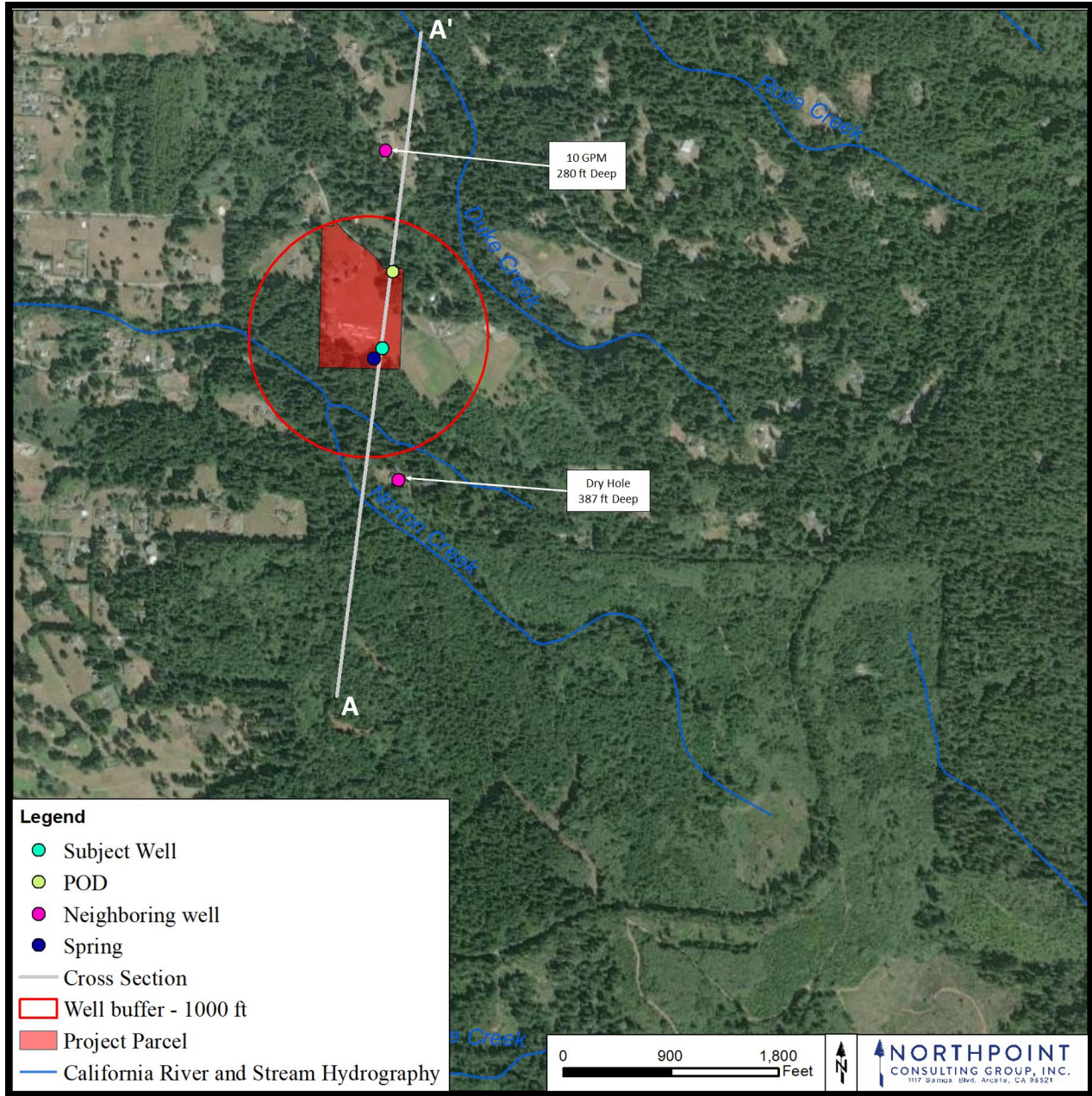


Figure 8: The Project Parcel (red polygon) shown on the with hydrogeologic cross section, nearby wells, and water features (POD = existing point of diversion).



## HYDROGEOLOGIC CONCEPTUAL MODEL

To evaluate the surface water connectivity of the project's well, a conceptual hydrogeologic model (Figure 9) for cross section A-A' (Figure 8) was developed using the available information from the WCRs for the project well and two closest neighboring wells; local geology; and nearby surface water and groundwater information. WCRs for the project's well and the closest neighboring wells are provided in Attachment 2. Groundwater recharge to the large, unconfined aquifer occurs by rainfall infiltration (DWR, 2004).

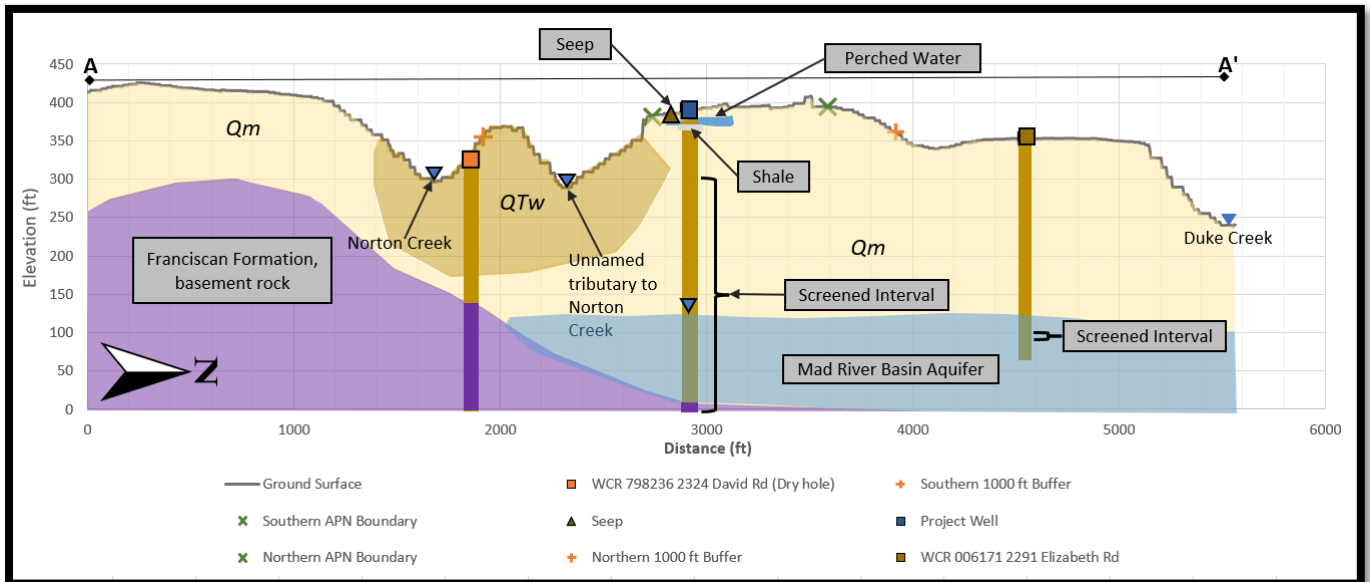


Figure 9: Hydrogeologic conceptual cross-section of the transect shown in Figure 8.

## IMPACTS TO SURFACE WATER AND ADJACENT WATER USERS

Based on the available hydrogeologic information, there is evidence that the project's water source is likely not directly connected to the unnamed tributary to Norton Creek. The nearby seep appears to be perched water that is disconnected from the well due to the overlying shale layer reported in the geologic log and due to the fact that the well is sealed to 20 ft BGS, cased to 100 ft BGS, and screened below 100 ft BGS. To support this conclusion, water quality samples were taken from the well and seep in high-density polyethylene bottles (pre-cleaned of trace metals) on October 24, 2022. The well pump was allowed to run for approximately 10-minutes prior to the collection of the water sample. The water was sampled directly from the well head, prior to any in-line filtration of groundwater. Water from the seep was sampled via the collection of dripping water directly from the seep. Water samples were sent to A&L Laboratories (Modesto, California, Attachment 3). The water quality results were mapped on a Piper Diagram for comparison (Figure 10). The water quality results provide evidence supporting that the samples are from different water sources. Therefore, the well is unlikely drawing water from this perched layer.

As demonstrated in this TM, with the proposed expansion, approximately 127,300 gallons and 171,800 gallons of well water would be needed to offset reclaimed water and rainwater collection during an average and dry year, respectively and would replace the existing surface water diversion of 120,000 gallons per year. Thus, only a net increase of 7,300 gallons and 51,800 gallons of groundwater extraction during an average year and a dry year, respectively (*Table 4* and *Table 5*); which is less than 0.001% of



the usable storage capacity, 10,500 acre-feet (DWR, 2004), of the groundwater basin and less than 0.5% of the annual precipitation (10,500,000 gallons), over the 16-acre project parcel, during a dry year.

Reclaimed water and rainwater collection would supply the majority of the projected irrigation demand; approximately 72%–79% (Table 3). Well water would be needed to offset the irrigation demand during the summer months at a rate of approximately 0.7–3.1 gpm (Table 4 and Table 5), assuming the well is pumped over an 8-hour pumping period, during daylight hours, as the pump is solar powered (the pump has a maximum capacity of 5.9 gpm). The greatest demand from the well would be expected to occur in July through August. The California Department of Water Resources (DWR, 2004) provided an estimate of the annual groundwater extraction in the groundwater basin to be 2,180 acre-feet for agricultural and industrial uses. The project projects up to 171,800 gallons (0.53 acre-feet) of well water use, which is only 0.024% of the overall extraction for agricultural and industrial uses and proposes a net increase of only 51,800 gallons (0.16 acre-feet), which is only 0.007% of the overall groundwater basin extraction.

Although determined for humid basins in the east, the USGS (USGS Fact Sheet 2007-3007) estimated long-term average recharge to be between 10 and 66 percent of precipitation. Over the 16-acre project parcel area this would equate to 3.2 – 21.3 acre-feet per year (AFY) during a dry year and 6.6 –43.6 AFY during an average year. The project's groundwater demand is only 12% of the lowest long-term average recharge estimate of 3.2 AFY (1,042,700 gallons) over the 16-acre project parcel.

No wells were identified in the WCR documents within 1,000 ft of the project well that would likely be impacted from groundwater extraction for the proposed project. Additionally, this region receives substantial annual rainfall, which, given the relatively low local density of wells, is expected to recharge the groundwater aquifer, even during dry years as evidenced during the site visit in October 2022, which occurred during a period of extreme drought. During these site visits, surface water features demonstrated flowing water in the absence of significant rainfall events.

Since there is sufficient groundwater supply and annual recharge to meet the project's demand during average and dry years; there is sufficient groundwater storage; there is evidence that the project's well is likely not connected to surface water; the project is situated in an area of low population and well densities; there is little to no impact to surrounding wells; and with the proposed use of a combination of reclaimed water and rainfall collection; the proposed project well water use would have a less than significant impact on groundwater, surface water, or water users in the vicinity of the proposed project.



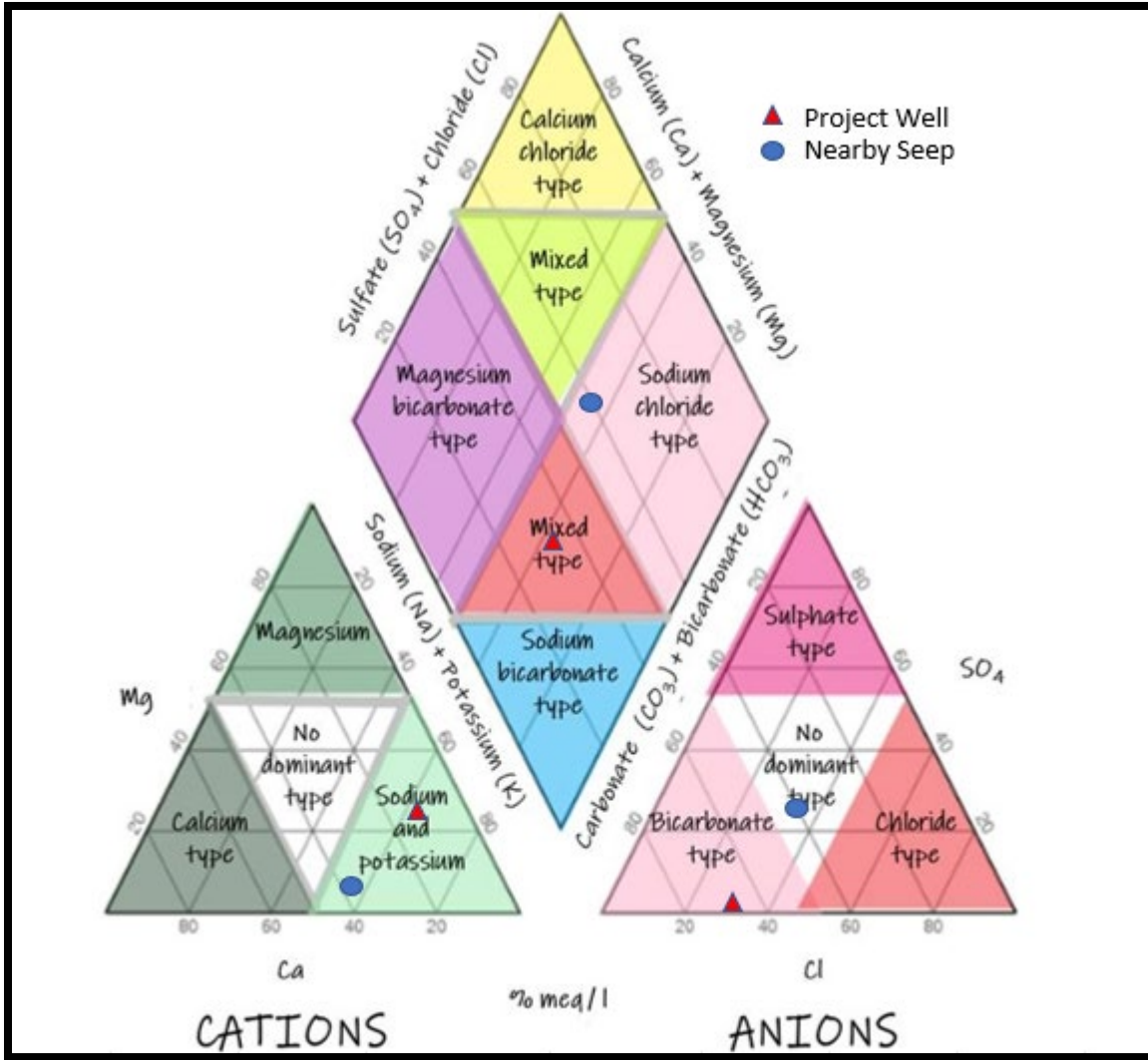


Figure 10. Piper Diagram of water quality analysis results.

### QUALIFICATIONS OF AUTHORS

Dr. Dodd has a PhD in Water Resources Engineering. In addition, Dr. Dodd is registered Professional Engineer with the State of California with 30-years of experience practicing and teaching Water Resources Engineering, including over 15 years of teaching, practicing, and modeling surface and groundwater hydrology.

### LIMITATIONS

The study of groundwater hydrology is very complex and often relies on limited data, especially in rural areas. Recommendations and conclusions provided herein are based on professional judgment made using information of the groundwater systems and geology in Humboldt County, which is limited and allows only for a general assessment of groundwater aquifer conditions and recharge. NorthPoint Consulting Group, Inc. is making analyses, recommendations, and conclusions based on readily available



data, including studies and reports conducted by other professionals, Humboldt County, the State of California, and other consultants hired by the project proponent to prepare technical studies for the proposed project. If additional information or data becomes available for the project area, the recommendations and conclusions presented herein may be subject to change. This report has been prepared solely for the client and any reliance on this report by third parties shall be at such party's sole risk.

#### **ATTACHMENTS:**

1. Mad River Groundwater Basin, Dows Prairie Subbasin, Bulletin 118 (DWR, 2004)
2. Well Completion Reports
3. Water Quality Test Results

#### **REFERENCES**

- ECD Holdings, Inc. Cultivation and Operations Manual prepared by NorthPoint Consulting Group, Inc., March 2023.
- ECD Holdings, Inc. Development Plans prepared by NorthPoint Consulting Group, Inc. dated March 2023.
- California DWR (2003). California's Groundwater Bulletin 118 Update 2003. October 2003.  
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- McLaughlin, R.J., S.D. Ellen, M.C. Blake, Jr., A.S. Jayko, W.P. Irwin, K.R. Aalto, G.A. Carver, and S.H. Clarke, Jr. 2000. Geology of the Cape Mendocino, Eureka, Garberville, and Southwestern part of the Hayfork 30 x 60 Minute Quadrangles and Adjacent Offshore Area, Northern California. USGS Pamphlet to accompany Miscellaneous Field Studies MF-2336.
- USGS. 2007. USGS Fact Sheet 2007-3007. <https://pubs.usgs.gov/fs/2007/3007/>



# **Attachment 1:**

## **Dows Prairie Subbasin, Bulletin 118**





## **Mad River Groundwater Basin, Dows Prairie Subbasin**

- Groundwater Basin Number: 1-8.02
- County: Humbolt
- Surface Area: 14,000 acres ( square miles)

### **Basin Boundaries and Hydrology**

The Dows Prairie Subbasin is located on the coast north of the Mad River Lowland Subbasin and is bounded by Little River to the north and Mad River to the south. The subbasin is bounded to the east by the Franciscan Formation (Strand 1962). The region is an elevated terrace drained by Mill Creek, Strawberry Creek, and White Creek. Development of groundwater is primarily in the western portion of the subbasin. The Hookton Formation is the main geologic unit in the area. The Franciscan Formation underlies the Hookton Formation and is essentially nonwater-bearing.

Annual precipitation in the basin ranges from 39- to 53-inches, increasing to the northeast.

### **Hydrogeologic Information**

The following information is taken from DWR (1965) unless noted otherwise.

#### ***Water-Bearing Formations***

The Quaternary Hookton Formation is the water-bearing formation in the subbasin.

**Pleistocene Hookton Formation.** The Hookton Formation consists of clay, sand, and thin gravel beds. Near McKinleyville, the formation is at least 150 feet thick and may be over 200 feet thick in other areas. The formation has moderately low permeability and supplies unconfined groundwater to many domestic wells. Sanding is a problem in most wells. Little information is available regarding groundwater in the eastern portion of the subbasin.

#### ***Recharge Areas***

Recharge occurs by rainfall infiltration.

#### ***Groundwater Level Trends***

Seasonal fluctuations of groundwater levels in the subbasin range from 9 to 11-feet.

#### ***Groundwater Storage***

##### **Groundwater Storage Capacity.**

The usable storage capacity for the western portion of the basin is estimated to be 10,500 acre-feet. This estimate is based on a saturated depth interval of 10 to 150-feet, a surface area of 6,500 acres, and a specific yield of 11 to 12-percent.

### **Groundwater Budget (Type B)**

Estimates of groundwater extraction are based on a survey conducted by the California Department of Water Resources in 1996. The survey included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 2,100 and 80 acre-feet respectively. Deep percolation from applied water is estimated to be 500 acre-feet.

### **Groundwater Quality**

**Characterization.** The major water types in the basin is calcium-magnesium bicarbonate and magnesium-sodium bicarbonate waters. Total dissolved solids range from 55- to 145-mg/L (DWR unpublished data).

### **Water Quality in Public Supply Wells**

<b>Constituent Group<sup>1</sup></b>	<b>Number of wells sampled<sup>2</sup></b>	<b>Number of wells with a concentration above an MCL<sup>3</sup></b>
Inorganics – Primary	2	0
Radiological	2	0
Nitrates	3	0
Pesticides	1	0
VOCs and SVOCs	1	0
Inorganics – Secondary	2	2

<sup>1</sup> A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).

<sup>2</sup> Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.

<sup>3</sup> Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

### **Well Characteristics**

	<b>Well yields (gal/min)</b>	
Irrigation	NKD	
	<b>Total depths (ft)</b>	
Domestic	Range: 19 - 455	Average: 78 (289 Well Completion Reports)
Municipal/Irrigation	Range: 36 - 300	Average: 104 (6 Well Completion Reports)

NKD – No known data.

## Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	
DWR	Miscellaneous water quality	3 wells biennially
Department of Health Services and cooperators	Miscellaneous water quality	

## Basin Management

Groundwater management:	No known groundwater management plans, groundwater ordinances, or basin adjudications.
Water agencies	
Public	Fieldbrook CSD, McKinleyville CSD, Humboldt Bay MWD, Manila CSD
Private	

## Selected References

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## Errata

Changes made to the basin description will be noted here.

# **Attachment 2: Well Completion Reports**



State of California  
**Well Completion Report**  
 Form DWR 188 Submitted 3/31/2021  
 WCR2021-004045

**Project's Well  
 Report**

Owner's Well Number W2215 Date Work Began 03/09/2021 Date Work Ended 03/16/2021  
 Local Permit Agency Humboldt County Department of Health & Human Services - Land Use Program  
 Secondary Permit Agency \_\_\_\_\_ Permit Number 20/21-0650 Permit Date 01/15/2021

Well Owner (must remain confidential pursuant to Water Code 13752)	Planned Use and Activity
Name _____	Activity <u>New Well</u>
Mailing Address _____	Planned Use <u>Water Supply Irrigation - Agriculture</u>
City _____ State _____ Zip _____	

Well Location	
Address _____	APN <u>511-141-015</u>
City <u>McKinleyville</u> Zip <u>95519</u> County <u>Humboldt</u>	Township _____
Latitude <u>40 58 4.9079 N</u> Longitude <u>-124 5 5.82 W</u>	Range _____
Deg. Min. Sec. Deg. Min. Sec.	Section _____
Dec. Lat. <u>40.96803</u> Dec. Long. <u>-124.08495</u>	Baseline Meridian _____
Vertical Datum _____ Horizontal Datum <u>WGS84</u>	Ground Surface Elevation _____
Location Accuracy _____ Location Determination Method _____	Elevation Accuracy _____
	Elevation Determination Method _____

Borehole Information	
Orientation <u>Vertical</u> Specify _____	
Drilling Method <u>Direct Rotary</u> Drilling Fluid <u>Bentonite</u>	
Total Depth of Boring <u>400</u> Feet	
Total Depth of Completed Well <u>400</u> Feet	

Water Level and Yield of Completed Well	
Depth to first water <u>16</u> (Feet below surface)	
Depth to Static _____	
Water Level <u>260</u> (Feet) Date Measured <u>03/16/2021</u>	
Estimated Yield* <u>15</u> (GPM) Test Type <u>Air Lift</u>	
Test Length <u>4</u> (Hours) Total Drawdown <u>140</u> (feet)	
*May not be representative of a well's long term yield.	

Geologic Log - Free Form		
Depth from Surface Feet to Feet		Description
0	1	top soil/grass
1	21	brown silty clay
21	28	brown sand & Tree
28	34	shale clay
34	71	brown silty clay
71	76	brown sand & Tree
76	96	brown silty clay
96	121	brown sand (clean)
121	223	brown silty clay
223	261	brown sand(clean)
261	294	brown silty clay
294	318	large brown birds eye sand
318	389	brown silty clay
389	393	shale clay

**RECEIVED**  
 APR 1 2021  
 HUMBOLDT CO. DIVISION  
 OF ENVIRONMENTAL HEALTH

393	400	blue clay & Tree
-----	-----	------------------

Casings										
Casing #	Depth from Surface Feet to Feet		Casing Type	Material	Casings Specifications	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if any (Inches)	Description
1	0	100	Blank	PVC	OD: 5.563 in.   SDR: 21   Thickness: 0.265 in.	0.265	5.563			
1	100	400	Screen	PVC	OD: 5.563 in.   SDR: 21   Thickness: 0.265 in.	0.265	5.563	Milled Slots	0.032	

Annular Material					
Depth from Surface Feet to Feet		Fill	Fill Type Details	Filter Pack Size	Description
0	20	Bentonite	Other Bentonite		Sanitary Seal
20	400	Filter Pack	Other Gravel Pack		#3 Well Sand

**Other Observations:**

Borehole Specifications		
Depth from Surface Feet to Feet		Borehole Diameter (Inches)
0	400	10

Certification Statement			
I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief			
Name <u>FISCH DRILLING</u>			
Person, Firm or Corporation			
<u>3150 JOHNSON ROAD</u>	<u>HYDESVILLE</u>	<u>CA</u>	<u>95547</u>
Address		City	State Zip
Signed <u><i>[Signature]</i></u>	<u>electronic signature received</u>	<u>03/31/2021</u>	<u>683865</u>
C-57 Licensed Water Well Contractor		Date Signed	C-57 License Number

Attachments
Location Map.pdf - Location Map

DWR Use Only			
CSG #	State Well Number	Site Code	Local Well Number
		N	W
Latitude Deg/Min/Sec		Longitude Deg/Min/Sec	
TRS:			
APN:			

State of California  
**Well Completion Report**  
 Form DWR 188 Auto-Completed 7/26/2021  
 WCR2021-006171

2291 Elizabeth Road  
 McKinleyville, CA 95521

Owner's Well Number \_\_\_\_\_ Date Work Began 05/10/2021 Date Work Ended 05/11/2021  
 Local Permit Agency Humboldt County Department of Health & Human Services - Land Use Program  
 Secondary Permit Agency \_\_\_\_\_ Permit Number 20/21-0961 Permit Date 04/07/2021

Well Owner (must remain confidential pursuant to Water Code 13752)			
Name	XXXXXXXXXXXXXXXXXXXX		
Mailing Address	XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX		
City	State	Zip	XXXXX

Planned Use and Activity	
Activity	<u>New Well</u>
Planned Use	<u>Water Supply Domestic</u>

Well Location					
Address	<u>2291 Elizabeth</u>		APN	<u>511-491-005</u>	
City	<u>McKinleyville</u>	Zip	<u>95519</u>	County	<u>Humboldt</u>
Latitude	<u>40</u> <u>58</u> <u>20.1691</u> <u>N</u>	Longitude	<u>-124</u> <u>5</u> <u>4.4483</u> <u>W</u>	Township	<u>07 N</u>
	Deg. Min. Sec.		Deg. Min. Sec.	Range	<u>01 E</u>
Dec. Lat.	<u>40.9722692</u>		Dec. Long.	<u>-124.084569</u>	
Vertical Datum	_____		Horizontal Datum	<u>WGS84</u>	
Location Accuracy	_____		Location Determination Method	_____	
			Baseline Meridian	<u>Humboldt</u>	
			Ground Surface Elevation	_____	
			Elevation Accuracy	_____	
			Elevation Determination Method	_____	

Borehole Information	
Orientation	<u>Vertical</u> Specify _____
Drilling Method	<u>Direct Rotary</u> Drilling Fluid <u>Bentonite</u>
Total Depth of Boring	<u>280</u> Feet
Total Depth of Completed Well	<u>280</u> Feet

Water Level and Yield of Completed Well	
Depth to first water	<u>100</u> (Feet below surface)
Depth to Static	_____
Water Level	<u>50</u> (Feet) Date Measured <u>05/12/2021</u>
Estimated Yield*	<u>10</u> (GPM) Test Type <u>Pump</u>
Test Length	<u>4</u> (Hours) Total Drawdown _____ (feet)
*May not be representative of a well's long term yield.	

Geologic Log - Free Form		
Depth from Surface Feet to Feet		Description
0	3	Brown Top Soil
3	15	Yellow Clay
15	55	yellow Sand W/ Wood
55	65	Wood W/ Yellow Sandy Clay
65	100	Yellow Sandy Clay
100	110	Birds Eye Gravel
110	130	Yellow Clay
130	165	Blue Clay
165	190	Yellow Sandy Clay
190	225	Blue Clay
225	246	Yellow Sandy Clay
246	255	Birds Eye w/ Sand
255	280	Sandy Yellow Clay



**Casings**

Casing #	Depth from Surface Feet to Feet		Casing Type	Material	Casings Specificatons	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if any (inches)	Description
1	0	250	Blank	PVC	OD: 5.563 in.   SDR: 17   Thickness: 0.327 in.	0.327	5.563			
1	250	260	Screen	PVC	OD: 5.563 in.   SDR: 17   Thickness: 0.327 in.	0.327	5.563	Bridge Slot	0.032	
1	260	280	Blank	PVC	OD: 5.563 in.   SDR: 17   Thickness: 0.327 in.	0.327	5.563			

**Annular Material**

Depth from Surface Feet to Feet		Fill	Fill Type Details	Filter Pack Size	Description
0	20	Bentonite	Other Bentonite	3/8	3/8 Hole Plug
20	280	Filter Pack	Other Gravel Pack		Pea Gravel

**Other Observations:**

**Borehole Specifications**

Depth from Surface Feet to Feet		Borehole Diameter (inches)
0	280	10

**Certification Statement**

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name RICH WELL DRILLING & PUMP SERVICE INC  
Person, Firm or Corporation

1251 RAILROAD DRIVE MC CA 95519  
Address City State Zip

Signed electronic signature received 05/21/2021 902702  
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

**DWR Use Only**

CSG #	State Well Number	Site Code	Local Well Number

<div style="display: flex; justify-content: space-between;"> <span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span> </div> <b>N</b>	<div style="display: flex; justify-content: space-between;"> <span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span><span> </span> </div> <b>W</b>
---	---

**Latitude Deg/Min/Sec                          Longitude Deg/Min/Sec**

TRS:

APN:

FEB 18 2004

STATE OF CALIFORNIA  
WELL COMPLETION REPORT  
Refer to Instruction Pamphlet

DWR USE ONLY - DO NOT FILL IN

**07N/01E-29A**

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

Owner's Well No. WW-1 No. **798236**

Date Work Began 10-15-03, Ended 10-22-03

Local Permit Agency Humboldt County Environmental Health

Permit No. 03/04-0116 Permit Date 8-11-03

GEOLOGIC LOG

ORIENTATION ( )  VERTICAL  HORIZONTAL  ANGLE  (SPECIFY)

DRILLING METHOD air rotary FLUID none

DEPTH FROM SURFACE		DESCRIPTION
Ft.	to Ft.	
0	17	Silty clayey sand
17	185	Silty sands
185	190	Silty clay
190	205	Coarse sand
205	238	Sand w/some gravels
238	252	Sand and gravels
252	263	Weathered shale
263	387	Shale w/clay seams

2324 David Road  
McKinleyville, CA 95521

WELL LOCATION

Address 2324 David Road

City McKinleyville

County Humboldt

APN Book 511, Page 171 Parcel 061

Township 07N Range 01E Section 29

Latitude \_\_\_\_\_ Longitude \_\_\_\_\_

LOCATION SKETCH

ACTIVITY ( )

NEW WELL

MODIFICATION/REPAIR

Deepen

Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES ( )

WATER SUPPLY

Domestic  Public

Irrigation  Industrial

MONITORING

TEST WELL

CATHODIC PROTECTION

HEAT EXCHANGE

DIRECT PUSH

INJECTION

VAPOR EXTRACTION

SPARGING

REMIEDIATION

OTHER (SPECIFY)

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER dry (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL \_\_\_\_\_ (Ft.) & DATE MEASURED \_\_\_\_\_

ESTIMATED YIELD \* \_\_\_\_\_ (GPM) & TEST TYPE \_\_\_\_\_

TEST LENGTH \_\_\_\_\_ (Hrs.) TOTAL DRAWDOWN \_\_\_\_\_ (Ft.)

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

TOTAL DEPTH OF BORING 387 (Feet)

TOTAL DEPTH OF COMPLETED WELL 0 (Feet)

DEPTH FROM SURFACE	BORE-HOLE DIA. (Inches)	CASING (S)						DEPTH FROM SURFACE	ANNULAR MATERIAL				
		TYPE ( )				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)		GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)	TYPE		
Ft.	to Ft.	BLANK	SCREEN	CONDUIT	FILL PIPE								
0	22	X				Steel	6	.188					
22	240	X				Steel	6	.188			X		
240	260	X				Steel	6	.188	1/8				
260	263	X				Steel	6	.188					
263	387					Open hole							

ATTACHMENTS ( )

Geologic Log

Well Construction Diagram

Geophysical Log(s)

Soil/Water Chemical Analyses

Other \_\_\_\_\_

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Diamond Core Drilling, Inc.  
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS P.O. Box 491925 Redding CA 96049  
CITY STATE ZIP

Signed [Signature] 2-06-04 512406  
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

07NO1E-29H Mc Kinleyville

Do Not Fill In

STATE OF CALIFORNIA THE RESOURCES AGENCY DEPARTMENT OF WATER RESOURCES WATER WELL DRILLERS REPORT

No 73932

CONFIDENTIAL LOG

State Well No. Water Code Sec. 13752 Other Well No.

ORIGINAL File with DWR

Well APN is Project Parcel APN, but well no longer exists per property owner

(1) WELL LOG:

Total depth 200 ft. Depth of completed well 200 ft. Formation: Describe by color, character, size of material, and structure

Clay 0-15

Yellow Sand 15-45

wood 45-95

Clay 95-100

Sand Gravel 100-145

Sand 145-180

180-200 water

Gravel

(2) LOCATION OF WELL:

County Humboldt Order's number, if any

Township, Range and Section

Distance from cities, roads, railroads, etc. AP# 511-141-15

(3) TYPE OF WORK (check): New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ] If destruction, describe material and procedure in Item 12.

(4) PROPOSED USE (check): Domestic [X] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] (5) EQUIPMENT: Rotary [ ] Cable [X] Other [ ]

Table with columns: From ft., To ft., Diam., Casing or Wall, Diameter of Bore, From ft., To ft.

Size of throat or well riser: Describe joint welded

(7) PERFORATIONS OR SCREENS

Table with columns: From ft., To ft., Perf. per row, Rows per ft., Size in x in

(8) CONSTRUCTION:

Was a casing permit and provided? Yes [X] No [ ] To what depth 45 ft. Were any casing seals against pollution? Yes [ ] No [ ]

(9) WATER LEVELS: Depth at which water was first found, if known 182 ft. Standing level before perforations, if known 180 ft. Standing level after perforating and developing 180 ft.

(10) WELL TESTS: Was pump test made? Yes [X] No [ ] If yes, by whom Rich Well: 4 1/2 gal./min. with total ft. drawdown after 4 hrs. Temperature of water: Was a chemical analysis made? Yes [ ] No [ ]

CONFIDENTIAL LOG Water Code Sec. 13752

Well started 2/24/74 Completed 2/24/74 WELL DRILLER'S STATEMENT: This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief. NAME Rich Drilling & Pumping Co. Address 1251 Railroad Ave. McKinleyville, CA [SIGNED] James J. Sullivan (Well Drilling) License No. 246499 Dated 2/24/74

SKETCH LOCATION OF WELL ON REVERSE SIDE

# **Attachment 3: Water Quality Test Results**





# A & L Western Laboratories, Inc.

1311 Woodland Avenue, Modesto CA 95351 209-529-4080  
 10220 SW Nimbus Avenue Bldg. K-9, Portland OR 97223 503-968-9225

## Ag Suitability Water Analysis

WYETH WUNDERLICH  
 NORTHPOINT CONSULTING GROUP INC  
 1117 SAMOA BLVD  
 ARCATA, CA 95521

Order Number: 38575  
 Lab Number: W38575-01  
 Submitted Date: 10/26/2022  
 Report Date: 11/2/2022  
 Submitted By: WYETH WUNDERLICH

P.O. #: CHECK #3319

**Grower: NORTHERN EMERALDS WELL & SURFACE**

mg/L = milligrams/liter = part per million = ppm  
 meq/L = milliequivalents/liter  
 dS/m = deciSiemen/meter = mmhos/cm  
 lbs/ac-ft = pounds/acre-foot

**Description: NE SPRING**

**Analytes**

pH (pH)	6.2	pH units
Electrical Conductivity (EC)	0.05	dS/m
Boron (B)	<0.01	mg/L
Iron (Fe)	<0.01	mg/L
Copper (Cu)	<0.01	mg/L
Manganese (Mn)	<0.01	mg/L

**Normal Values**

6.5 to 8.0  
 0.5 to 3.0  
 <0.5

**Problem Values**

<6.5 or >8.0  
 <0.5 or >3.0  
 >0.5

**Cations**

	mg/L	meq/L	lbs/ac-ft
Calcium (Ca)	3.5	0.18	9.5
Magnesium (Mg)	0.7	0.06	1.9
Sodium (Na)	4.7	0.21	12.7
Potassium (K)	0.5	0.01	1.3

**Normal Values mg/L**

30 to 400  
 1 to 60  
 <70

**Problem Values mg/L**

<30  
 [Mg]>[Ca]  
 >70

**Anions**

	mg/L	meq/L	lbs/ac-ft
Bicarbonate (HCO <sub>3</sub> )	5.3	0.09	14.2
Chloride (Cl)	4.6	0.13	12.5
Nitrate - Nitrogen (NO <sub>3</sub> -N)	1.6	0.11	4.3
Sulfate - Sulfur (SO <sub>4</sub> -S)	3.3	0.10	9.0

**Normal Values mg/L**

<150  
 <150  
 <10

**Problem Values mg/L**

>300  
 >200  
 >10

**Calculated Values**

Total Dissolved Solids (TDS)	35	mg/L
Sodium Absorption Ratio (SAR)	0.6	
SAR/EC Ratio (SEC)	11.9	
pHc (pHc)	10.3	

**Normal Values**

1 to 1,500  
 <6.0  
 <5.0

**Problem Values**

>1,900  
 >6.0  
 >10.0

<8.4 may add Ca >8.4 may remove Ca

**Gypsum Requirements**

**100% gypsum equivalent (lbs/ac-ft)**

Eatons Gypsum Requirement (EGR)	50
Residual Sodium Carbonate (RSC)	0

**pH Titration Results**

**Volume of Concentrated Sulfuric Acid (fl-oz/100gal)**

Target pH (7.0)	
Target pH (6.5)	
Target pH (6.0)	0.02

*Sam Modest*

Sam Modest - Chemist

contact@vtaglab.com

RED = Value of Concern



# A & L Western Laboratories, Inc.

1311 Woodland Avenue, Modesto CA 95351 209-529-4080  
 10220 SW Nimbus Avenue Bldg. K-9, Portland OR 97223 503-968-9225

## Ag Suitability Water Analysis

WYETH WUNDERLICH  
 NORTHPOINT CONSULTING GROUP INC  
 1117 SAMOA BLVD  
 ARCATA, CA 95521

Order Number: 38575  
 Lab Number: W38575-02  
 Submitted Date: 10/26/2022  
 Report Date: 11/2/2022  
 Submitted By: WYETH WUNDERLICH

P.O. #: CHECK #3319

### Grower: NORTHERN EMERALDS WELL & SURFACE

mg/L = milligrams/liter = part per million = ppm  
 meq/L = milliequivalents/liter  
 dS/m = deciSiemen/meter = mmhos/cm  
 lbs/ac-ft = pounds/acre-foot

### Description: NE WELL

#### Analytes

pH (pH)	6.5	pH units
Electrical Conductivity (EC)	0.13	dS/m
Boron (B)	<0.01	mg/L
Iron (Fe)	<0.01	mg/L
Copper (Cu)	<0.01	mg/L
Manganese (Mn)	<0.01	mg/L

#### Normal Values

6.5 to 8.0  
 0.5 to 3.0  
 <0.5

#### Problem Values

<6.5 or >8.0  
 <0.5 or >3.0  
 >0.5

#### Cations

	mg/L	meq/L	lbs/ac-ft
Calcium (Ca)	5.2	0.26	14.1
Magnesium (Mg)	3.2	0.27	8.6
Sodium (Na)	13.3	0.58	36.0
Potassium (K)	0.5	0.01	1.2

#### Normal Values mg/L

30 to 400  
 1 to 60  
 <70

#### Problem Values mg/L

<30  
 [Mg]>[Ca]  
 >70

#### Anions

	mg/L	meq/L	lbs/ac-ft
Bicarbonate (HCO <sub>3</sub> )	33.1	0.54	89.3
Chloride (Cl)	15.0	0.42	40.4
Nitrate - Nitrogen (NO <sub>3</sub> -N)	1.1	0.08	2.9
Sulfate - Sulfur (SO <sub>4</sub> -S)	1.7	0.05	4.6

#### Normal Values mg/L

<150  
 <150  
 <10

#### Problem Values mg/L

>300  
 >200  
 >10

#### Calculated Values

Total Dissolved Solids (TDS)	90	mg/L
Sodium Absorption Ratio (SAR)	1.1	
SAR/EC Ratio (SEC)	8.6	
pHc (pHc)	9.0	

#### Normal Values

1 to 1,500  
 <6.0  
 <5.0

#### Problem Values

>1,900  
 >6.0  
 >10.0

<8.4 may add Ca >8.4 may remove Ca

#### Gypsum Requirements

#### 100% gypsum equivalent (lbs/ac-ft)

Eatons Gypsum Requirement (EGR)	94
Residual Sodium Carbonate (RSC)	3

#### pH Titration Results

#### Volume of Concentrated Sulfuric Acid (fl-oz/100gal)

Target pH (7.0)	
Target pH (6.5)	
Target pH (6.0)	0.16

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RED = Value of Concern