NORTHPOINT
CONSULTING GROUP, INC.

REGISTERED PROFESSIONAL ENGINEER
ANNJANETTE DODD
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Exp. 6/30/2023
CIVIL
STATE OF CALIFORNIA

TECHNICAL MEMORANDUM

To: Lake County Community Development Department

From: Annjanette Dodd, PhD, CA PE #77756

Date: August 19, 2021

Subject: Ordinance 3106 Hydrology Report – UP 20-21 High Valley Oaks Inc.
9850 High Valley Road, Clearlake Oaks, (APN 006-004-19)

INTRODUCTION AND PURPOSE

On July 27, 2021, the Lake County Board of Supervisors passed an Urgency Ordinance (Ordinance 3106) requiring land use applicants to provide enhanced water analysis during a declared drought emergency. Ordinance 3106 requires that all projects that require a CEQA analysis of water use include the following items in a Hydrology Report prepared by a licensed professional experienced in water resources:

- Approximate amount of water available for the project's identified water source,
- Approximate recharge rate for the project's identified water source, and
- Cumulative impact of water use to surrounding areas due to the project.

The purpose of this Technical Memorandum (TM) is to provide the information required by Ordinance 3106 for UP 20-21, High Valley Oaks. In addition to the Hydrology Report, Ordinance 3106 requires a Drought Management Plan (DMP) depicting how the applicant proposes to reduce water use during a declared drought emergency. The DMP for this project has been submitted as a separate document.

PROJECT LOCATION

The project is located 9850 High Valley Road, Clearlake Oaks, Lake County, California (APN 006-004-19). The project site is located approximately 4-miles northwest of Clearlake Oaks.

PROPOSED PROJECT

The project proposes 4-acres of outdoor cannabis cultivation without the use of light deprivation and/or artificial lighting. The proposed cultivation will be distributed within approximately six (6) acres of cultivation area.

PROJECT WATER DEMAND

The CalCannabis Environmental Impact Report (CDFA, 2017) uses 6.0 gallons per day per plant as an estimated water demand for cannabis cultivation. This is 1.0 gallons (gpd) per plant more than reported by Bauer et. el. (2015), who reported up to 5.0 (gpd) per plant (18.9 Liters/day/plant). Using the more conservative estimate of 6.0 gpd, and assuming there are approximately 500 plants per acre of canopy

(CDFA, 2017), the demand is 3,000 gpd (2.1 gallons per minute [gpm]) per acre of canopy; this use rate is consistent with the Water Use Management Plan section (Section 15.2) of the project's Property Management Plan. The total water demand for 4-acres of canopy is approximately as follows:

- Daily – 12,000 gpd (8.2 gpm)
- Yearly
  - 120 day cultivation season – 4.4 acre-feet (AF)
  - 180 day cultivation season – 6.6 AF

WATER SOURCE AND SUPPLY

There is one (1) existing, permitted groundwater well that will be used for cultivation (Lat/Long 39.066528, -122.731757). The well is approximately 320 feet deep and was drilled in March of 2020. The well is screened between 260- and 320-feet below the ground surface (well log is attached to this TM). Using USGS topography, the elevation of the bottom of the well is at approximately 2,560-feet.

When the well was drilled, it was estimated to have a yield of 100 gpm (161.3 acre-feet per year). A 5-Horsepower (HP) pump, with a maximum output of 43 gpm, has been installed the well. On May 4, 2021, a 4-hour well drawdown test was conducted using 43 gpm; the static water level was 206-feet with a drawdown of 2-feet during the test. The drawdown test results are attached to this TM. Based on the size of the pump, it would take 4.7 hours to supply the daily demand of 12,000 gallons. The annual demand is approximately 2.7-4.1% of the annual well production in acre-feet (based on the well yield estimated when the well was drilled).

IRRIGATION AND WATER STORAGE

Irrigation for the cultivation operation will use water supplied by the existing well and 5-HP pump. The irrigation water would be pumped from the well, via PVC piping, to four (4), 5,000-gallon water storage tanks, totaling 20,000 gallons of water storage, and then delivered to a drip irrigation system. The drip lines will be sized to irrigate the cultivation areas at a rate slow enough to maximize absorption and prevent runoff. Drip irrigation systems, when done properly, conserve water compared to other irrigation techniques.

GROUNDWATER BASIN INFORMATION AND HYDROGEOLOGY

The well is located on a ridge in an undefined groundwater basin within the Franciscan Formation. The ridge is located above the High Valley Groundwater Basin (Basin #5-16) located approximately 1-mile to the southeast and the Long Valley Groundwater Basin (Basin #5-31) located approximately 2-miles to the northeast. (Figure 1)

The High Valley Basin is within the Schindler Creek Watershed and includes High Valley, a small valley about 3-miles long and 1-mile wide. The contact between the Jurassic-Cretaceous Franciscan Formation bounding the valley alluvium generally defines the basin boundary to the north, west, and south. Quaternary Holocene volcanics border the basin to the east. The valley is drained by Schindler Creek, flowing east and south, and eventually into Clearlake. There are two water bearing formations in the High Valley Basin, an unconfined aquifer within the Quaternary Alluvium, approximately 100-feet deep, and a confined aquifer within the Holocene Volcanics, below the alluvium. According to the Lake County

Groundwater Management Plan, the average-year agricultural groundwater demand in the High Valley basin is approximately 36 AF per year. However, a recent report presented to the Lake County Planning Commission (Kimley-Horn, 2021) stated the demand is about ten times this amount. Wells in the valley range in depth between 25-feet and 650-feet. Surface topography in the valley ranges between 1,920-feet and 1,720-feet. (CDM 2006 and California DWR 2003, 2021)

The Long Valley Basin is located within a narrow elongated valley, bounded on most sides by the Franciscan Formation. A small portion of the southern boundary consists of Quaternary volcanic rocks. The valley is drained by Long Valley Creek, flowing southeast, and eventually into Cache Creek. Very little information exists about the hydrogeology of this groundwater basin. Average-year agricultural groundwater demand in the Long Valley Basin is approximately 250 AF per year. Wells in the valley range in depth between 25-feet and 225-feet. Surface topography in the valley ranges between 1,550-feet and 1,150-feet. (CDM 2006 and California DWR 2003, 2021)

Neither of these basins have been identified by the California Department of Water Resources (DWR) as critically overdrafted basins. 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 in order to help 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. Both the High Valley and the Long Valley Basins were ranked as very low-priority basins by the CASGEM ranking system. (DWR, 2021)

Figure 1. Well Location and Mapped Groundwater Basins

RECHARGE RATE

The elevation of the bottom of the project's water well is approximately 2,560-feet; well above the High Valley and Long Valley Basins. Due to the lack of information regarding groundwater in the vicinity of the well, it is unknown whether the source water is within an isolated aquifer or contributes recharge to the High Valley or Long Valley Basins.

The annual recharge can be estimated using a water balance equation, where recharge is equal to precipitation (P) less runoff (Q) and abstractions that do not contribute to infiltration (e.g., evapotranspiration). A simple tool that can be used to estimate runoff and abstractions, that uses readily available data, is the Natural Resources Conservation Service (NRCS) Curve Number (CN) Method (NRCS, 1986). Determination of the CN depends on the watershed's soil and cover conditions, cover type, treatment, and hydrologic condition. The CN Method runoff equation is

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

where

Q = runoff (inches)
P = rainfall (inches)
S = potential maximum retention after runoff begins (inches) and
I_a = initial abstraction (inches)

The initial abstraction (I_a) represents all losses before runoff begins, including initial infiltration, surface depression storage, evapotranspiration, and other factors. The initial abstraction is estimated as $I_a = 0.2S$. S is related to soil and cover conditions of the watershed through the CN, determined as $S = 1000/CN - 10$. Using these relations, the runoff equation becomes:

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

The CN is estimated based on hydrologic soil group (HSG), cover type, condition, and land use over the area of recharge. The approximate recharge area around the site, delineated using the well bottom elevation, is 0.4-square miles (256 acres). (Figure 2)

The recharge area soils are classified into four HSGs (A, B, C, and D) according to the soils ability to infiltrate water; where HSG A has the highest infiltration potential and HSG D has the lowest infiltration potential. HSGs are based on soil type and are determined from the NRCS Web Soil Survey. The recharge area is comprised of two HSGs: 75% C and 25% D (Figure 3). The land use is undeveloped with a cover type of brush in fair (50% to 75% ground cover) condition and has CNs of 70 and 77 for HSGs C and D, respectively. The weighted CN for the recharge area is 72.

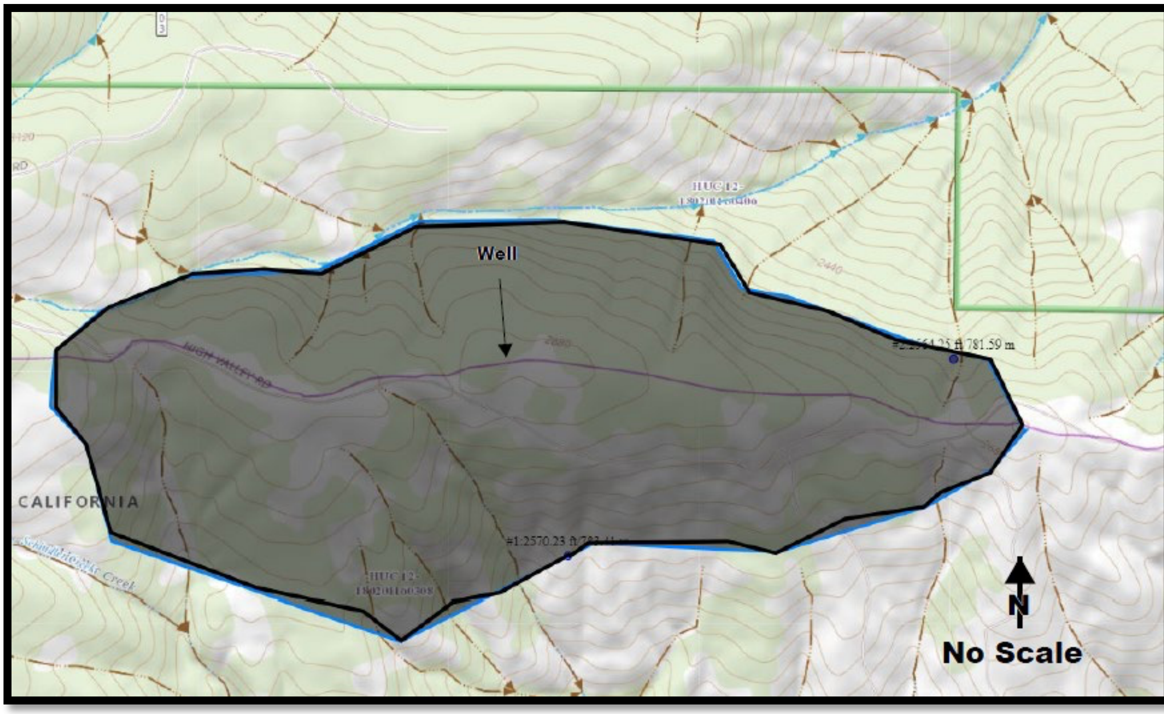

Figure 2. Approximate Recharge Area

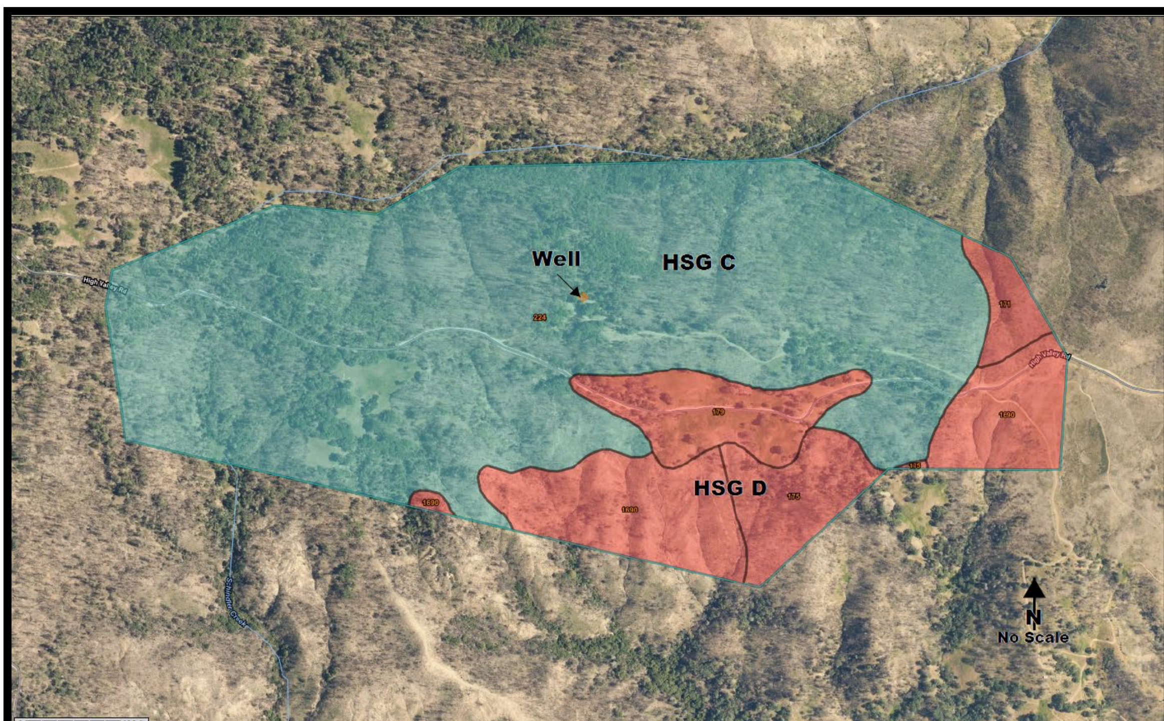

Figure 3. NRCS Soil Survey Hydrologic Soil Groups (Blue=HSG C, Red=HSG D) (source: https://websoilsurvey.sc.egov.usda.gov/)

The PRISM Climate Group gathers climate observations from a wide range of monitoring networks and provides time series values of precipitation for individual locations (https://prism.oregonstate.edu/explorer/). Using the annual precipitation from 1895 to 2020, as predicted by PRISM, the annual average precipitation over this period is 43.5 inches and the minimum precipitation over this period is 9.7 inches.

Using the above information, and assuming that 50% of the initial abstraction infiltrates and the remainder is evapotranspiration (0.39 inches or 8.3 AF), the estimated annual recharge over the recharge area of 0.4-square miles is 84 AF during an average year and 66 AF during a dry year (Table 1).

Table 1. Estimated annual recharge over the recharge area of the project's well.

Recharge Area (acres)	P (inches)	CN	S (inches)	I_a (inches)	Q (inches)	Recharge = $P - Q - 0.5*I_a$ (inches)	Recharge (AF)
256	9.7	72	3.89	0.78	6.2	3.1	66
256	43.5	72	3.89	0.78	39.2	4.0	84

Cumulative Impact to Surrounding Areas

Annual water demand of the proposed project could be up to 6.6 AF per year, depending on the length of the cultivation season, which is approximately 8% and 10% of the annual recharge during an average and dry year, respectively. Over, the project would need 0.31-inches of rainfall to infiltrate into the recharge area to meet the project's demand. Thus, there is enough recharge, on an annual basis, to meet the project's demand.

In addition, the project is located in a very rural area with no nearby development. There are no known wells within the 0.4-square mile recharge area. From review of Google Earth Imagery and California Department of Water Resources (DWR) Well Completion Report Map Application, there appears to be a well approximately 0.8 miles to the northwest on another ridge and 0.6 miles to the southeast. Both wells are outside the recharge area.

Because the groundwater basin is undefined, the recharge rate was determined using an estimate of the recharge area, and the in-situ characteristics of the water source (e.g., perched aquifer, localized confined aquifer, or confined/unconfined aquifer part of a larger system). It is recommended that the project applicant monitor water levels in the well. The purpose of the monitoring is to evaluate the functionality of the well to meet the long-term water demand of the proposed project. Water level monitoring is required by the Lake County Zoning Ordinance. Ordinance Article 27 Section 27.11(at) 3.v.e. requires the well to have a water level monitor. Recommendations for well water level monitoring are provided below.

<u>Seasonal Static Water Level Monitoring</u>: The purpose of seasonal monitoring of the water level in the well is to provide information regarding long-term groundwater elevation trends. It is recommended that the water level in the well be measured and recorded once in the Spring (March/April), before cultivation activities begin, and once in the fall (October) after cultivation is complete. (note: The California Statewide Groundwater Monitoring Program (CASGEM) monitors semi-annually around April 15 and October 15). Records shall be kept, and elevations reported to the County as part of the project's annual reporting requirements. Reporting shall include a hydrograph plot of all seasonal water level measurements beginning with the initial measurement. Seasonal water level trends will aid in the evaluation of the recharge rate of the well. For example, if the water level measured during the Spring remains relatively

constant from year to year, then the water source is recharging each year.

Water Level Monitoring During Extraction: The purpose of monitoring the water level in the well during extraction is to evaluate the performance of the well to determine the effect of the pumping rate on the water source during each cultivation season. This information shall be used to determine the capacity and yield of the well to aid the cultivators in determining pump rates and the need for water storage. The frequency of water level monitoring will depend on the source, the source's capacity, and the pumping rate. It is recommended that initially the water level be monitored twice per week or more, and that the frequency be adjusted as needed depending on the impact the pumping rate has on the well water level. Records shall be kept and elevations reported to the County as part of the project's annual reporting requirements. Reporting shall include a hydrograph plot of the water level measurements during the cultivation season and compared to prior seasons.

Measuring a water level in a well can be difficult and the level of difficulty will depend on site-specific conditions. As part of the well monitoring program, the well owner/operator shall work with a well expert to determine the appropriate methodology and equipment to measure the water level in their well(s) as well as who will conduct the monitoring and recording of the well level data. The methodology of the well monitoring program shall be described and provided in the project's annual report.

In addition to monitoring and reporting, an analysis of the water level monitoring data shall be provided and included in the project's annual report, demonstrating whether or not use of the well is causing significant drawdown and/or impacts to the surrounding area and what measures were taken to reduce impacts. If there are impacts, a revised Water Management Plan shall be prepared and submitted to the County, for review and approval, demonstrating how the project will mitigate the impacts in the future.

With required monitoring and reporting and the requirement of a revised Water Management Plan for review and approval, the proposed project water use would not have a cumulative impact on the surrounding area.

Qualifications of Author

I am a registered Professional Engineer with the State of California with 30-years of experience practicing and teaching Water Resources Engineering.

References

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Attachments:

1. Well Log
2. Draw Down Test Results

High Valley Oaks Inc.
Well Log

Geologic Log

Orientation ● Vertical ○ Horizontal ○ Angle Specify

Drilling Method Air Rotary/Mud Rotary Drilling Fluid Bentonite

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	20	Brown Clay
20	50	Brown Clay with sandstone
50	60	Brown Shale
60	120	Black Shale
120	320	Black Shale/sandstone/calsite

Total Depth of Boring 325 Feet

Total Depth of Completed Well 320 Feet

Well Owner

Name Tim Wrinkler

Mailing Address 245 Paula Ln

City Petaluma State CA Zip 94952

Well Location

Address 9850 High Valley Rd.

City Clearlake Oaks County LAKE

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ___ Dec. Lat. ___ Dec. Long. ___

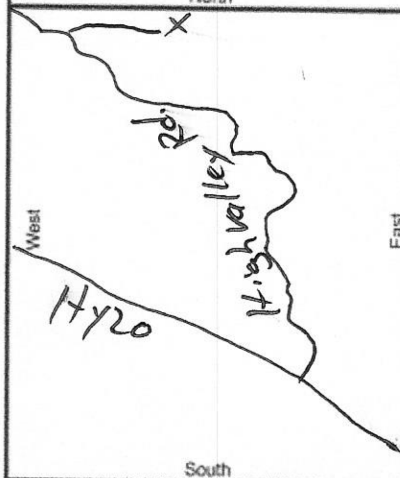
APN Book 006 Page 004 Parcel 19

Township ___ Range ___ Section ___

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North



West

East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. **Please be accurate and complete.**

Activity

● New Well

○ Modification/Repair

○ Deepen

○ Other ___

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

● Water Supply

☒ Domestic ☐ Public

☒ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

○ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ___

Water Level and Yield of Completed Well

Depth to first water 120' (Feet below surface)

Depth to Static Water Level 120' (Feet) Date Measured 3-12-20

Estimated Yield * 100+ (GPM) Test Type Air lift

Test Length 2 HRS (Hours) Total Drawdown ___ (Feet)

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

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	260	9"	F480	PVC	1/4"	5"	Blank	—
260	320	9"	F480	PVC	1/4"	5"	Perfs	.035

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	1	Concrete	SEAL
1	24	Bentonite	
24	320	5/16 Pea	Gravel Pack

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 Will Petersen Well Drilling
Person, Firm or Corporation

P.O. Box 695 Kelseyville CA 95451
Address City State Zip

Signed [signature] 3-16-20 1009053
C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

High Valley Oaks Inc
Well Test Results

CAL-TECH PUMP WELL & WATER TREATMENT
P.O. Box 1261
Middletown, CA 95461
Ph. 707-987-4488
www.cal-techpump.com
State License # 923640
Fax. 707-987-4411

Well Inspection Log

For: Kim Gardner

Ph: 415-637-6456

Site: 9850 High Valley Rd
Project:
Escrow #:
Email: kimlichtergardner@gmail.com

Start Date: 5/4/21

Technician: Joe

WELL DEPTH	CASING SIZE	STATIC LEVEL	PUMP TYPE	PUMP SETTING	MAX PUMP OUTPUT	TOTAL DRAWDOWN	DEAD HEAD	AMPS	VOLTAGE
320'	4.5" PVC	206'	45GPM 5Hp Submersible Pump & Motor	2" sch. 80	43	208'	N/A	N/A	240v

DATE	TIME	TECH	WATER LEVEL	GAL.PER MINUTE	WATER COLOR	WATER METER	COMMENTS
5/4/2021	1:45	Joe	206	43	Clear/cold	372,200	
	1:47	Joe	206	43	Clear/cold		
	2:01	Joe	206.5	43	Clear/cold		
	2:15	Joe	206.5	43	Clear/cold		
	2:35	Joe	207	43	Clear/cold		
	3:05	Joe	207	43	Clear/cold		
	3:53	Joe	207	43	Clear/cold		
	5:06	Joe	207.5	43	Clear/cold		
	5:45	Joe	208	43	Clear/cold	382,500	
Recovery:	5:45	Joe	208				
	6:30	Joe	208				

Water Quality Sample Taken: Yes
Pump Broke Suction During Test: No
Total Pumping Time: 4 Hrs
Estimated Total Volume Pumped: 10,300
Well Yield For Duration Of Test: 43GPM