



United States Department of the Interior

NATIONAL PARK SERVICE
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, CO 80525

March 23, 2001

IN REPLY REFER TO:

L54(2380)
PINN/General

Memorandum

To: Superintendent, Pinnacles National Monument

Through: Wm. Jackson, Chief, Water Operations Branch

From: Larry Martin, Hydrogeologist, Water Resources Division

Subject: Proposed well at West Entrance

Summary: Pinnacles National Monument would like to move much of the development on the west side of the park from the Chaparral area to the West Entrance as described in Alternative B of the Development Concept Plan (NPS, 1991). A site for construction of a test well was selected in the meadow area where development is proposed near the West Entrance. Although hydrogeologic conditions are not very favorable, there is a fair chance of obtaining the necessary quantity of water from a well at this location.

Discussion: The area for the planned development is an open meadow on either side of the road, immediately north of the west entrance to Pinnacles National Monument. The entire area within about a mile of the site is underlain by granitic rocks. Granitic rocks are generally poor aquifers. Sufficient water for a domestic supply can sometimes be obtained from granitic rocks if the well intersects water-bearing fractures.

Well logs and driller's reports for several wells within about a mile north, west, and south of the proposed site were obtained from the California Department of Water Resources. These documents indicate that at least some of the wells will produce 3-10 gallons per minute (gpm). Production tests reported on these documents are generally short duration. We do not know whether these wells could sustain pumping at about 5 gpm for the several hours per day that would be required to supply the proposed development. Also, we need to remember that test holes that do not yield enough water for a domestic supply are frequently filled and abandoned, and a new well is drilled elsewhere on the property. There are no driller's reports for most of the abandoned or "dry" holes.

One of the park's nearest neighbors, the home located on the east side of the road at the turnoff to Chalone Vineyard (¾ mile south of the park entrance) reportedly has a well that reliably produces 10 gpm. The well supplies the home and irrigation water for a 1-acre vineyard.

In granitic terrain, production of water from a well is dependent on intersecting fractures. Sometimes the location of fractures or fracture zones can be interpreted by looking for linear features on topographic maps, particularly stream channels. Streams often follow zones of weakness in the rock (fracture zones) because the fractured rock is more easily eroded. The primary orientation of fractures is generally parallel to major structural features, such as faults. A secondary fracture orientation often occurs perpendicular to the primary orientation.

At Pinnacles, the primary orientation of fractures is most likely north-northwesterly, parallel to the Pinnacles Fault, Chalone Creek Fault, and also the San Andreas Fault about 5 miles east of Pinnacles.

Linear features in the vicinity of the West Entrance are shown on the attached map. Most of the linear features trend NNW, with smaller and less frequent features trending ENE. The recommended location for a test well is at the intersection of linear trending features, maximizing our chance of intersecting water-bearing fractures.

The recommended location for a test well near the West Entrance to Pinnacles National Monument is shown on the attached maps. The location could be on either side of the road, toward the southern part of the meadow. The well should be located slightly north of the well-defined creek channel in the southern part of the meadow.

The anticipated depth for constructing a test well at this site should be about 300 feet, with the option of continuing to 400 feet if some fractures are encountered, but the yield is not sufficient at 300 feet. If water is encountered, but the yield is low, the well could be reamed to 10-12 inches to provide more storage within the borehole and provide an "underground reservoir". Another option might be to hydrofrack the well, although hydrofracking is not a common practice in the area. Hydrofracking is a process of incrementally isolating successive sections of the borehole and applying great pressure by pumping water into the well until the rock fractures. Hopefully, some of the new fractures would intersect existing, water-bearing fractures in the rock, resulting in greater yield of water to the well.

Test drilling at the proposed development site might not locate a suitable water supply. Alternative sources of water include pumping water to the site from the existing well in the Chaparral area (approximately 8000 linear feet and 600 vertical feet) or purchasing water from the Chalone Vineyard.

References

Akers, J.P., 1967. The Geohydrology of Pinnacles National Monument, California. USGS Open-File Report, 14 pp.

Andrews, Phillip, 1936, Geology of the Pinnacles National Monument. University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 24, No. 1, 38 pp.

Evenson, R.E., 1962, Ground-Water Reconnaissance at Pinnacles National Monument, California. USGS Water-Supply Paper 1475-K, pp. 375-382

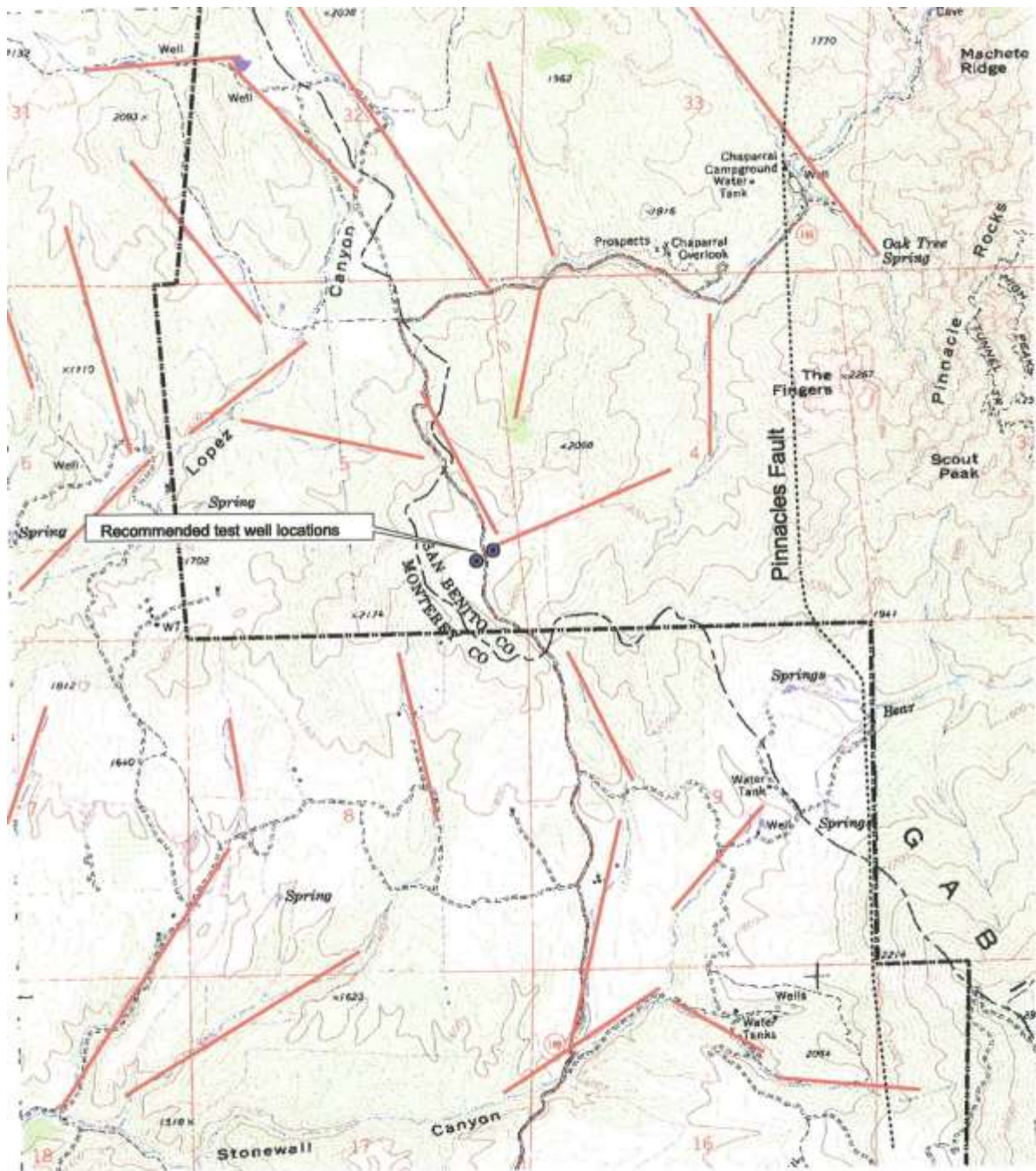
NPS, 1991, Development Concept Plan and Environmental Assessment, West District Pinnacles National Monument, California. 55 pp.

cc:

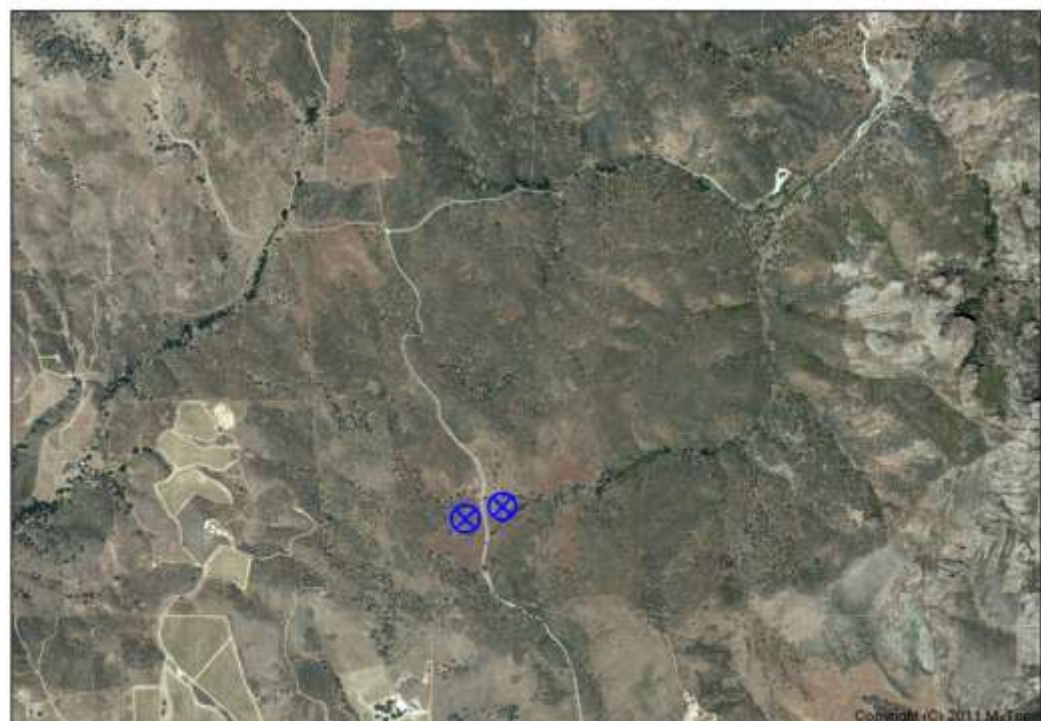
PINN – Ken Hutchison

PWR – Noby Ikeda

DSC – Ric Alesch, Steve Bainbridge



Linear features in the vicinity of the West Entrance. PINN



Recommended locations for a test well, West Entrance Pinnacles National Monument

Test Well at Pinnacles National Monument

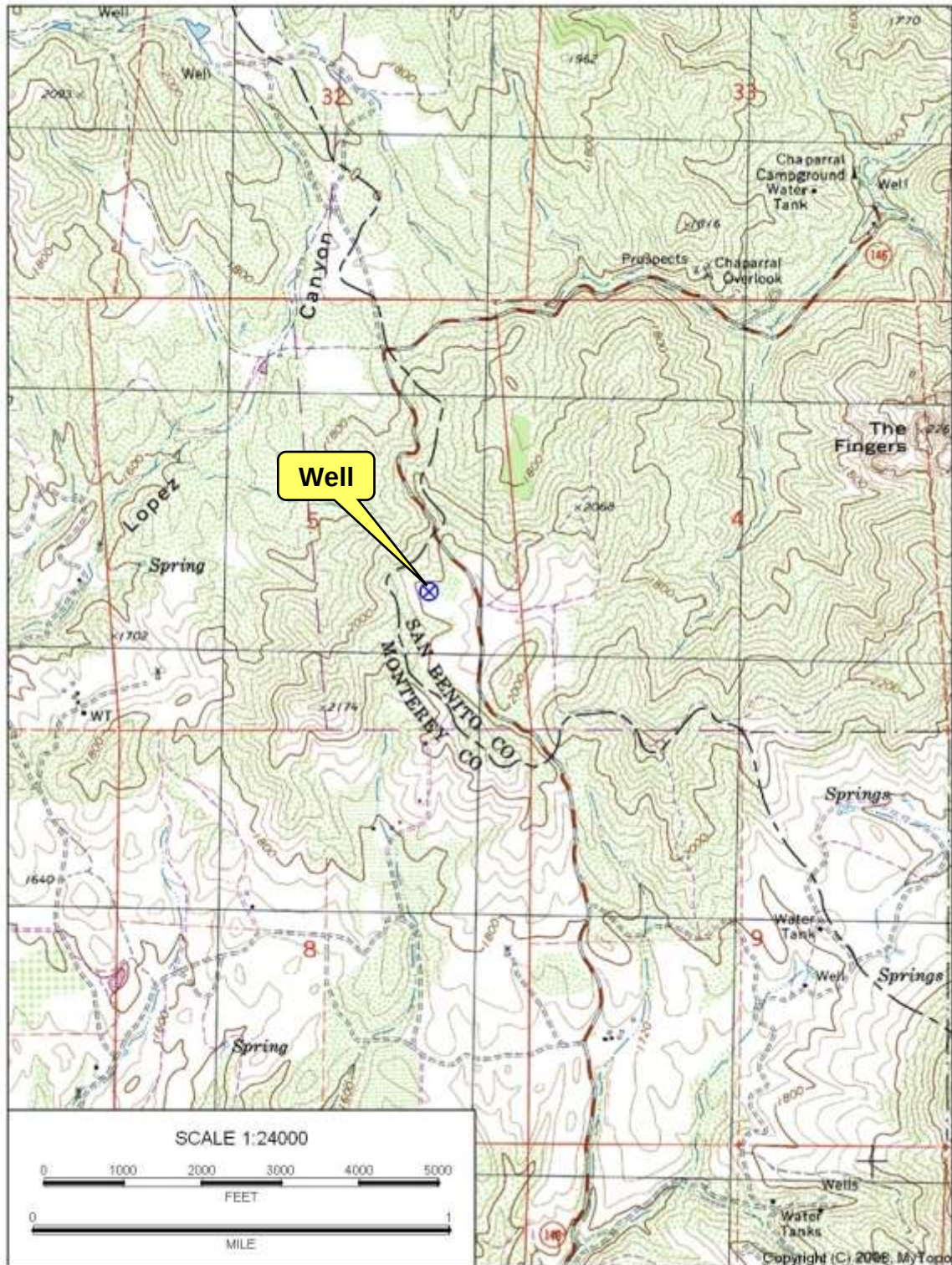
A test well was drilled on the west side of Pinnacles National Monument from Sept. 17-20, 2001. The well is located about 200 yards west of the road, about one-third of a mile north of the park boundary. The site is a SSW facing slope at the change from a grassy wet meadow type of vegetation to an upland shrub/scrub type of vegetation. The legal description of the location is SW $\frac{1}{4}$, NE $\frac{1}{4}$, SE $\frac{1}{4}$, Section 5, R7E, T17S.

The entire borehole was drilled through granitic rocks (granite, granodiorite, quartz diorite, quartz monzonite). Estimated yield is 5 gpm. A zone from about 200-220 feet continued to slough, causing problems when the drilling tools were run into the borehole or removed from the borehole. The driller plans to fill the hole with bentonite slurry to hold the hole open while installing the screen, casing, and gravel pack. The mud will then be pumped out and the well developed and tested for drawdown, recovery, and yield characteristics. The driller expects to complete this work about October 15.

The existing facilities on the west side use about 20,000 gallons during the busiest months. Most of their visitation is on weekends.

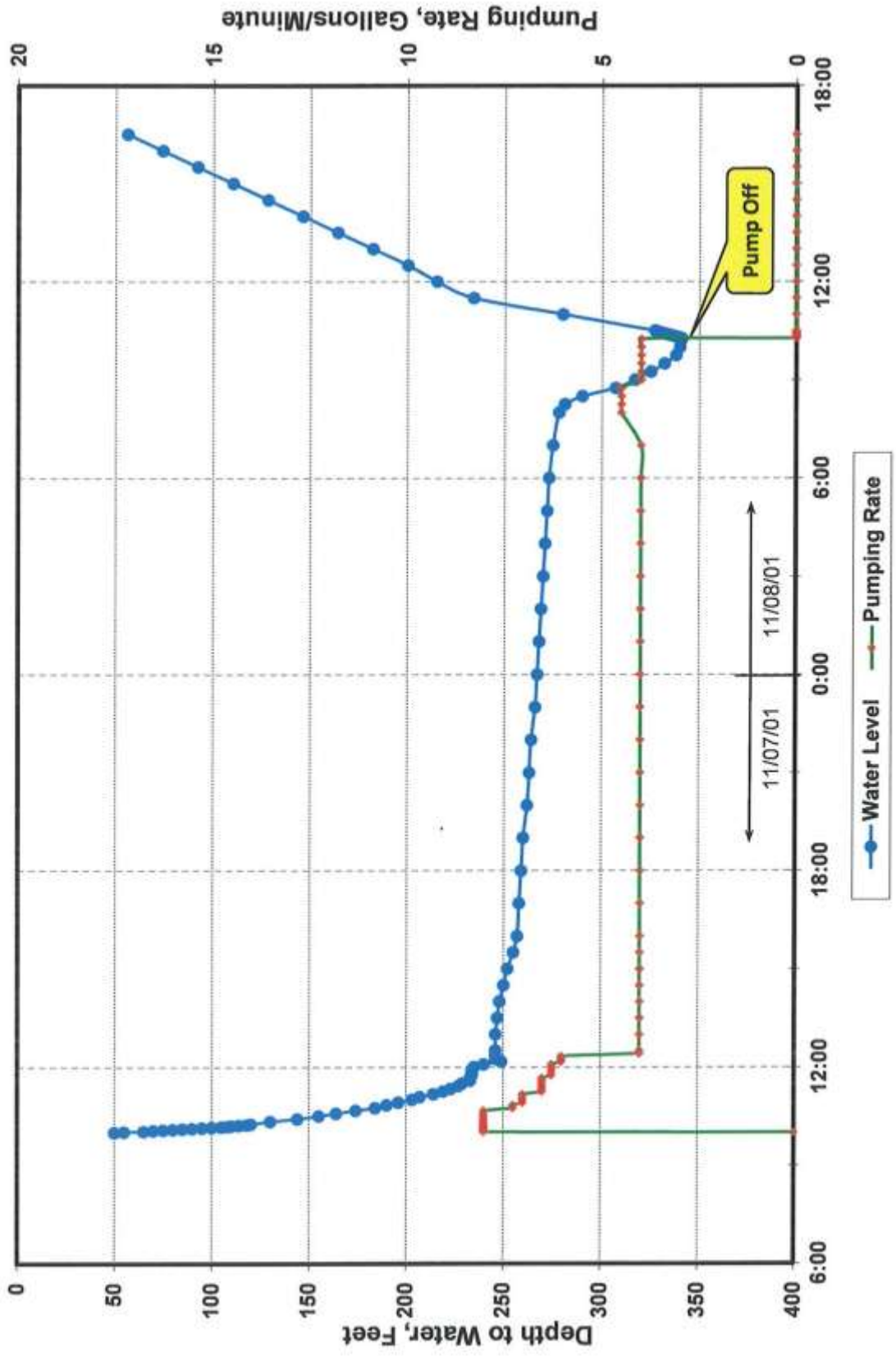
Fracture zones and potential water bearing zones were noted at these depths;

70 feet	fractures, no water
105-110 feet	fractures, no water
135 feet	fracture
198-230 feet	fractures, water bearing, possibly fault zone with claylike gouge
315-330 feet	fractures, some water
340-345 feet	fractures, some water
404-410 feet	fractures
415-418 feet	fractures



Actual location of the constructed well, September 2001

Pinnacles Test Well
at West Entrance



ORIGINAL
File with DWR

Page 1 of 1

Owner's Well No. 1 WEST

No. 761334

Date Work Began 9/17/01, Ended 11/08/01

Local Permit Agency SAN BENITO COUNTY - HEALTH DEPT.

Permit No. WP 01-035 Permit Date 09/10/01

STATE OF CALIFORNIA
WELL COMPLETION REPORT

Refer to Instruction Pamphlet

DWH. USE ONLY - DO NOT FILL IN	
STATE WELL NO. STATION NO.	
LATITUDE	LONGITUDE
APN/TH/OTHER	

GEOLOGIC LOG		
ORIENTATION (±)	☒ VERTICAL ☐ HORIZONTAL	ANGLE (SPECIFY)
DRILLING METHOD	ROTARY FLUID AIR/MUD	
DEPTH FROM SURFACE	DESCRIPTION	
PL TO PL	Describe material, grain size, color, etc.	
0 15	SOIL ZONE (SANDY) & SANDSTONE BROWN (HARD)	
15 38	DECOMPOSED GRANITE (BROWN)	
38 70	GRANITE (GRAY TO GREEN) HARD	
70 74	GRANITE (GRAY WITH QUARTZ) (FRACTURES - NO WATER)	
74 105	GRANODIORITE (GRAY W/QUARTZ)	
105 110	SAME WITH FRACTURES	
110 135	GRANITE W/QUARTZ (GRAY-GREEN)	
135 138	SAME WITH FRACTURES - H ₂ O SM	
138 198	GRANODIORITE (GRAY W/QUARTZ)	
198 240	GRANITE WITH LAYERS OF CLAY-LIKE SCHIST CONTAINING SOME VERY FINE SAND & GRAVEL (GRAY)	
	H ₂ O ZONE: 3.5 to 4.0 GPM	
240 425	GRANITE (GRAY TO BLACK) WITH QUARTZ FRACTURES INTERMITTENT VERY HARD FORMATION	
	NOTABLE FRACTURES & POSSIBLE SMALL AMOUNTS OF H ₂ O	
	315 TO 330 FT.	
	340 TO 345 FT.	
	404 TO 410 FT.	
	415 TO 418 FT.	

WELL OWNER	
Name	PINNACLES NATIONAL MONUMENT
Mailing Address	5000 HIGHWAY 146
CITY	PAICINES CA 95043
WELL LOCATION	
Address	WEST ENTRANCE TO PARK + 1/2 MI. NW
City	NEAREST CITY - SOLEDAD, CA 93960
County	SAN BENITO
APN Book	028 Page: 10-0 Parcel 013-0
Township	Range: Section
Latitude	Longitude

LOCATION SKETCH	ACTIVITY (±)
	☒ NEW WELL ☐ MODIFICATION/REPAIR ☐ Draper ☐ Other (Specify)
	☐ DESTROY (Specify Reasoning and Date) (Under "RECEIVED" ONLY)
	PLANNED USES (±)
	WATER SUPPLY
	Domestic ☒ Public ☐ ☐ Irrigation ☐ Industrial ☐
	MONITORING
	TRT WFL ☐ CATHODIC PROTECTION ☐ HEAT EXCHANGE ☐ DIRECT PUSH ☐ SUCTION ☐ VAPOR EXTRACTION ☐ SPARGING ☐ REMEDIATION ☐ OTHER (SPECIFY) ☐

FINISHED WELL WAS TEST PUMPED FOR 24 HRS. AT A SUSTAINED PRODUCTION RATE OF 4.0 G.P.M. FROM 50' - MAXIMUM DRAWDOWN WAS 291 FT. STATIC TEMP. OF WATER: 71.0 ° F.

TOTAL DEPTH OF BORING 430 (Feet)

TOTAL DEPTH OF COMPLETED WELL 425 (Feet)

WATER LEVEL & YIELD OF COMPLETED WELL	
DEPTH TO FIRST WATER	135 (PL) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL	50 (PL) & DATE MEASURED 11/07/01
ESTIMATED YIELD	4.0 (GPM) & TEST TYPE PUMP
TEST LENGTH	24 (HRS) TOTAL DRAWDOWN 291 (PL) FROM STATIC
* May not be representative of a well's long-term yield.	

DEPTH FROM SURFACE			BORE-HOLE DIA. (INCHES)	CASTING (S)						DEPTH FROM SURFACE			ANNULAR MATERIAL				
				TYPE (±)				MATERIAL GRADE	INTERNAL DIAMETER (INCHES)				GALVE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)	TYPE		
PL	TO	PL	BLANK	SCREEN	COARSE BLOWN	FINE PER						PL			TO	PL	OR. MENT (±)
0	55	14	X					SDR 21	6	.250		0	55	X			
55	200	10	X					SDR 21	6	.250		55	200				1" X #10
200	260	10		X				SDR 17	6	.325	.034	200	260				GRAVEL
260	300	10	X					SDR 21	6	.250		260	300				" "
300	320	10		X				SDR 17	6	.325	.034	300	320				
320	380	10	X					SDR 21	6	.250		380	425	SCREEN		.034	SLOT
ATTACHMENTS																	

ATTACHMENTS (±)

☒ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analysis

☐ Other

ATTACH ADDITIONAL INFORMATION IF IT EXITS

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

NAME MOUNTAIN HYDRO SYSTEMS			
(PERSON, FIRM OR CORPORATION) (TYPE OR NUMBER)			
ADDRESS	35504 RIVER ROAD	CITY	SOLEDAD CA 93960
SIGNED	<i>Harry Stokoleny</i>	DATE	11/14/01
WELL NUMBER	761334	PERMIT NO.	WP 01-035
DATE	11/14/01	DATE	11/14/01



GARY STOOKSBERRY

35504 RIVER ROAD

SOLEDAD, CA 93960

(831) ~~608~~ 675-9355

OFFICE PHONE

(831) 675-1615

OFFICE FAX

DATE: 11/12/01

FINAL TEST PUMPING REPORT
FOR PINNACLES WELL # 1
ORDER P 8450010699

1. WELL DEVELOPMENT PROCEDURE:

AFTER GRAVEL PACKING THE ANNULAR SPACE AROUND THE 6" PVC WELL CASING AND SCREEN, WE PUMPED 10.5 SACK (NEAT CEMENT) THRU TREMMIE PIPE FROM 56 FT. UP TO THE LAND SURFACE TO COMPLETE THE DRILLING & CASING PORTION OF PINNACLES WELL # 1 - WEST ENTRANCE.

AFTER THE CEMENT SEAL SOLIDIFIED, WE COMMENCED AIR DEVELOPMENT PROCEDURES ON OCT. 19, 2001. FROM OCT. 19 THRU OCT. 22 WE WORKED 4 TO 5 HOURS PER DAY TO CONDUCT AN AIR DEVELOPMENT PROGRAM AS DESCRIBED BELOW:

A MULTIPLE-JET, ORIFICED AIR JETTING TOOL WAS ASSEMBLED TO THE BOTTOM OF THE DRILL PIPE STRING AND INSTALLED TO A DEPTH OF 425 FT. (BOTTOM OF THE COMPLETED WELL)

COMPRESSED AIR WAS APPLIED THRU THE DRILL PIPE AND AIR-JETTING TOOL INTO THE VARIOUS SCREENED ZONES IN THE WELL CASING AND GRAVEL PACK MEDIA. AIR WAS APPLIED AT 950 CFM AND UP TO 180 PSI THRU THE 4 NOZZLE JETTING TOOL. EACH DAY WE WOULD START INTRODUCING COMPRESSED AIR AT THE 425 FT. LEVEL AND SLOWLY PULL THE DRILL TOOLS UP THRU EACH SCREENED INTERVAL WHILE ROTATING SLOWLY. AFTER WE REACHED THE UPPER MOST SCREENED INTERVAL, WE WOULD PROCEED BACK DOWN THE HOLE APPLYING COMPRESSED AIR AS WE WENT DOWN. WHEN BOTTOM WAS REACHED, WE WOULD SHUT OFF THE AIR, LET THE WELL RECUPERATE OR FILL BACK IN WITH WATER FROM THE FORMATION FOR ABOUT 1 HOUR. THEN WE WOULD REPEAT THE PROCESS.

AFTER 4 DAYS OF THIS REPEATED CLEANING AND WAITING PROCEDURE, THE WELL WAS PRODUCING NEARLY PERFECTLY CLEAN WATER. THE TOTAL AMOUNT OF SAND REMOVED FROM THE WELL IN THE FORM OF A VERY FINE, GREY SAND DID NOT EXCEED $\frac{1}{2}$ SQUAREYARD. ABOUT ONE STANDARD WHEEL BARROW FULL OF SAND.

2. INSTALLATION OF TEST PUMPS: SEVERAL LARGER PUMPS WERE INSTALLED INTO THE WELL WHICH WERE DESIGNED TO PUMP FROM 5.5 GPM UP TO 14 GPM. THESE PUMPS WERE USED TO PUMP THE WATER TABLE TO THE BOTTOM OF THE WELL AT VARIOUS PUMPING RATES OVER A 2 WEEK PERIOD. WE THEN LET THE WELL RECHARGE OVER NIGHT AND REPEATED THE PUMPING PROCESS THE NEXT DAY.

IN ORDER TO SLOW THE PUMPING RATE BELOW 5.5 G.P.M. ON A SUSTAINED BASIS, WE HAD TO INSTALL A 1/2 H.P. SUBMERSIBLE PUMP WHICH WOULD PRODUCE AS DEPICTED ON THE ATTACHED PUMP PERFORMANCE CURVE: AERMOTOR 5-5- 13 STG.

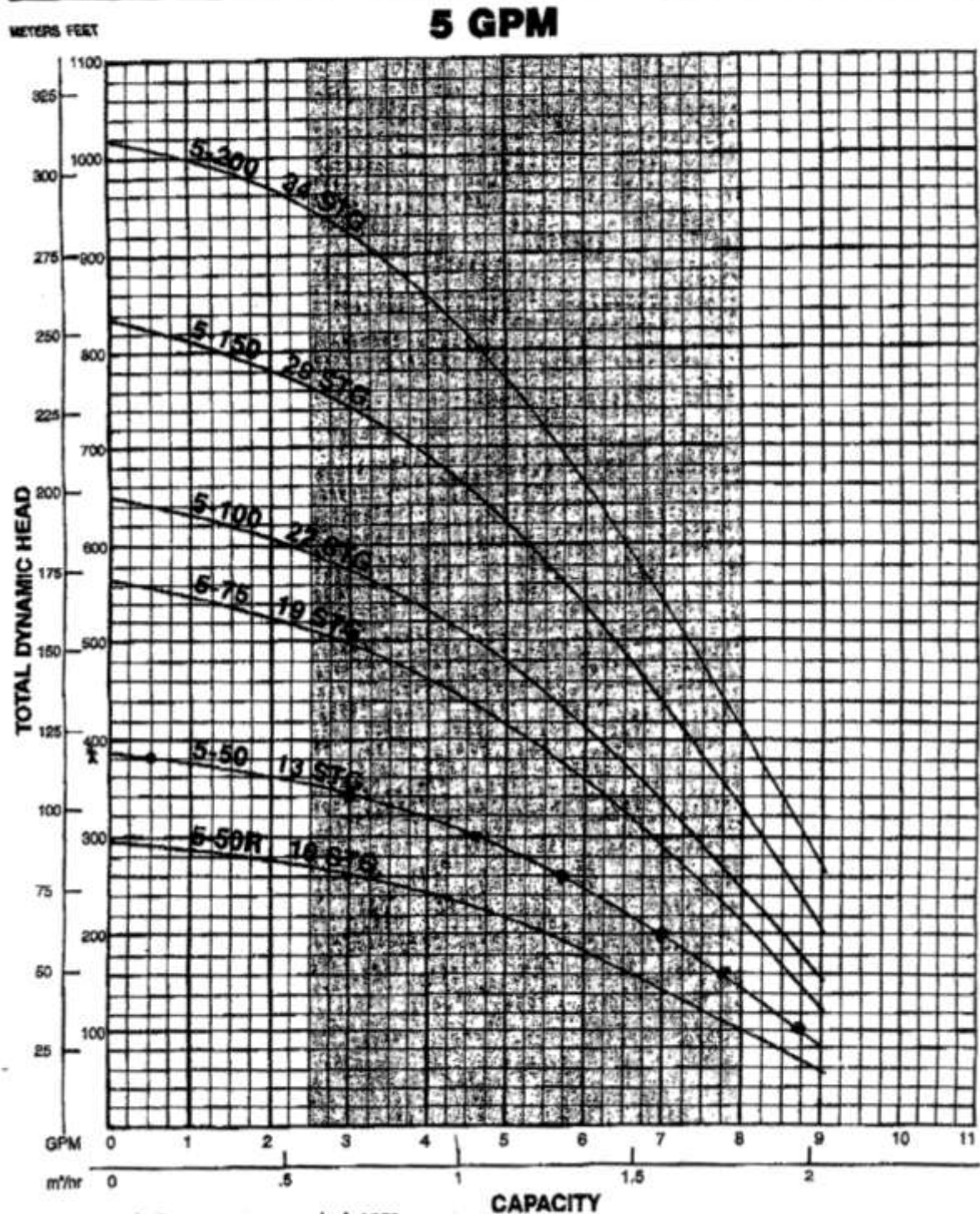
ESSENTIALLY: 8 GPM @ 100 FT.	7 GPM @ 200 FT.
6 GPM @ 241 FT.	5 GPM @ 280 FT.
4 GPM @ 320 FT.	2 GPM @ 360 FT.
1 GPM @ 378 FT.	

5 GPM

4" Submersible Pumps

COPY

ALUMINUM



FINAL TEST PUMPING REPORT

PINNACLES WELL # 1 - WEST ENTRANCE TO PARK

DATA FOR FINAL 24 HOUR SUSTAINED TEST PUMPING :

DATE AND HOUR AT START OF TEST: 11/07/01 10:00 A.M.
DATE AND HOUR AT END OF TEST: 11/08/01 10:15 A.M.
SUSTAINED PUMPING TIME: 24 HR. + 15 MINUTES

METER READING @ END OF TEST: 11,600.00 GALLONS
METER READING START OF TEST: - 6,300.00 " "
TOTAL GALLONS PUMPED 24 HRS. 5,300.00 " "

PUMP INSTALLED: AERMOTOR 5-50, 13 STAGE, $\frac{1}{4}$ H.P.

STATIC LEVEL (BEFORE PUMP WAS TURNED ON): 50 FT. BELOW SURFACE

COMMENTS	TIME	DRAW DOWN LEVEL	PUMPING RATE
START TEST	10:00 HRS.	@ <u>STATIC</u> OF 50 FT.	8 G.P.M.
MEASURE	10:01 HRS.	55 '	" "
DRAW-DOWN	10:02	65 '	" "
EVERY 1 MIN.	10:03	70 '	
	10:04	75 '	
FOR FIRST	10:05	80 '	
15 MINUTES	10:06	85	
	10:07	90	
	10:08	95	
	10:09	100 '	
	10:10	105	
	10:11	108	
	10:12	110	
	10:13	114	
	10:14	118 '	
	10:15	120	
MEASURE	10:20	130 '	
DRAW-DOWN	10:25	144	
EVERY 5 MIN.	10:30	155	
TO 1 HR.	10:35	164 '	
<u>AFTER-START</u>	10:40	174	
	10:45	184	7 $\frac{1}{2}$ G.P.M.
	10:50	190	
	10:55	196	7 G.P.M.
	11:00	203	
	11:05	207	
	11:10	214	
	11:15	219	6 $\frac{1}{2}$ G.P.M.
	11:20	223 '	
	11:25	227	
MEASURE	11:30	229	
DRAW DOWN	11:35	233	
EVERY 30	11:40	233	
MIN. AFTER	11:45	234 '	6 $\frac{1}{2}$ G.P.M.
	11:50	234	
12:30	11:55	234	
	12:00	235	
HEART OF			
AQUIFER			
233' TO 235'			

PAGE 3
FINAL TEST PUMPING REPORT
 PINNACLES WELL # 1 - WEST ENTRANCE TO PARK

DRAW DOWN DATA CONTINUED:

<u>COMMENTS</u>	<u>TIME</u>	<u>DRAW DOWN LEVEL</u>	<u>PUMPING RATE</u>
CONTINUE	12:05 HRS.	240 FT.	
5 MIN.	12:10	249	6.0 G.P.M.
INTERVALS	12:15	246	
	12:20	246	SLOW VALVE TO
	12:25	246	<u>4.0 G.P.M.</u>
	12:30	246	
	1:00	246	4.0 G.P.M.
30 MIN	1:30	247	
INTERVALS	2:00	248	
	2:30	250	
	3:00	252	
	3:30	255	
6 HRS. PUMP RUNNING	4:00	257	
	5:00	258	
1 HOUR	6:00	259	4.0 G.P.M.
INTERVALS	7:00	260	
	8:00	262	
	9:00	263	
	10:00	264	
	11:00	266	
	12:00	267	
11/08/01	1:00 AM	268	
	2:00	269	
	3:00	270	
	4:00	271	
	5:00	272	
	6:00	273	
	7:00	275	
	8:00	278	** INCREASED FLOW RATE TO 4.5 GPM
	8:15	281	
	8:30	290	
	8:45	307	
	9:00	317	** SLOWED RATE <u>BACK TO 4 GPM</u>
	9:15	325	
	9:30	332	
	9:45	338	
15 MINUTE	10:00	340	
INTERVALS	10:15	341	LAST DRAW DOWN READING
TURN OFF PUMP			
<u>START RECOVERY</u>	10:16	341	
	10:17	340	
	10:18	339	
	10:19	338	
	10:20	337	
	10:21	336	
	10:22	335	

PAGE 4
FINAL TEST PUMPING REPORT
PINNACLES WELL # 1 - WEST ENTRANCE TO PARK

RECOVERY OF WATER TABLE IN WELL AFTER SHUT DOWN OF PUMP (CONTINUED)

<u>COMMENTS</u>	<u>TIME</u>	<u>DRAW DOWN LEVEL</u> <u>RECOVERY LEVEL</u>	
	10:23	334	
	10:24	333	
	10:25	332	
	10:26	331	
	10:27	330	
	10:28	329	
	10:29	328	
	10:30	327	
MEASURE IN	11:00	280	
30 MINUTE	11:30	234	RECOVERED 46 '
INTERVALS	12:00	215	
	12:30	200	
	1:00	182	RECOVERED 18 '
	1:30	164	" "
	2:00	146	
	2:30	128	
	3:00	110	
	3:30	92	
	4:00	74	
	4:30	56	
			<u>STOPPED RECOVERY TEST</u> 10:16 TO 4:30

ABOUT 6 HRS. & 14 MIN
TO RECOVER TO 56 FT.

END OF TEST PUMP
6 RECOVERY PERIOD
REPORT DATA.....

CONCLUSIONS: EACH PERSON WHO STUDIES THESE NUMBERS MAY COME UP
WITH THEIR OWN CONCLUSION REGARDING THE PRODUCING ABILITY OF
THIS WELL ON A SUSTAINED BASIS.

I WOULD SUBMIT THAT THE WELL WILL PRODUCE RIGHT AT 4.0 G.P.M.
FOR A MINIMUM OF 24 HOURS WHILE DRAWING THE PRODUCING LEVEL DOWN
TO NO MORE THAN ABOUT 325 FT. ANY INCREASE TO THE PUMPING RATE
ABOVE 4 G.P.M. AT THE 325 FT. DEPTH WILL CAUSE THE WATER LEVEL
TO PUMP DOWN QUITE RAPIDLY.

ONCE THE STATIC HEAD IS PUMPED OFF (I.E. PUMP THE WELL DOWN
FROM STATIC LEVEL AT 50 FT. TO AROUND 233) AT A PUMPING RATE OF
8 G.P.M. GRADUALLY REDUCING TO 6½ G.P.M.; THE PRODUCING WATER
PUMPING LEVEL WILL HOLD AT BETWEEN 240 FT. TO 267 FT. AT A RATE
OF 4 G.P.M. FOR AT LEAST 12 HOURS. HOWEVER, THE DRAW DOWN DOES
CONTINUE TO INCH ITS WAY DOWN. THE PUMPING RATE MAY HAVE TO BE
ADJUSTED TO ABOUT 3.5 G.P.M. FOR SUSTAINABLE PUMPING BEYOND 24 HRS.

SINCERELY,
Gary Stooksberry
GARY STOOKSBERRY
MOUNTAIN HYDRO SYSTEMS