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February 25, 1989  
(17691-89)

Mr. Jack Bingham  
Project Manager  
Bond Gold Bullfrog, Inc.  
Post Office Box 519  
Beatty, Nevada 89003

**Subject: Final Monitoring Plan for Bullfrog Mine Wellfield  
Nye County, Nevada**

Dear Mr. Bingham:

Enclosed is what Hydro-Search, Inc. (HSI) understands is the final draft of the monitoring plan prepared in response to the water rights permits (#51841-48) issued by the State Engineer and the document submitted to the Nevada State Engineer by the National Park Service (NPS) on September 16, 1988. This plan is designed to address the concerns of Bond Gold, the Nevada State Engineer, Department of Fish and Wildlife, Bureau of Land Management, and the National Park Service. This draft (dated February 24, 1989) incorporates all suggested revisions as proposed in National Park Service response (dated February 9, 1989) on the January 19, 1989 version of the monitoring plan.

The plan includes monitoring high-discharge springs in the vicinity of Park Headquarters and one group of low-discharge springs at the Keane Wonder Mine. The low-discharge springs (pools or seeps) could be equipped with staff gages or a shallow pipe for monitoring water levels. High discharge springs near the Park Headquarters should be equipped with recording and measuring devices (weirs or flumes), to monitor discharge.

HSI proposes using the existing production and monitoring wells to measure water levels adjacent to the wellfield and within the projected area of drawdown. Four additional monitoring wells are proposed as agreed to in principal by the NPS, Fish & Wildlife, State Engineer, BLM, and Bond. Three of these wells will be installed to complete a line of monitoring wells between the Bullfrog Mine wellfield, the springs of Death Valley and wells in the central Amargosa farming area. The fourth well will be completed in Paleozoic rocks, near the Funeral Mountains, to monitor any possible alluvium-bedrock ground water interactions.

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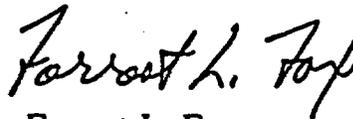
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A schedule for recording water levels and spring discharges has been described, as well as, recommendations for eventually decreasing the total number of monitoring wells.

If you should have any questions, please telephone HSI at (702) 322-4173.

Very truly yours

HYDRO-SEARCH, INC.



Forrest L. Fox  
Senior Hydrogeologist  
Assistant Project Manager

FLF/jen

cc: Owen R. Williams  
Peter G. Morros

**BOND GOLD BULLFROG, INC.**  
**WATER SUPPLY WELLFIELD MONITORING PROGRAM**  
**February 24, 1989**

**STATEMENT OF PURPOSES**

Included herein is a revised plan prepared by Hydro-Search, Inc. (HSI) to monitor potential impacts on ground water due to pumping of the Bullfrog Mine wellfield (Plate I). This plan has been updated from the November 16, 1988 submittal and is design to address the concerns outlined in the December 27, 1988 meeting with personnel from the National Park Service (NPS), Nevada State Engineer, Department of Fish and Wildlife, Bureau of Land Management, and Bond Gold.

This plan is designed to satisfy the monitoring plan condition requirements set forth in Nevada State Water Permits 51841 through 51848, inclusive and thereby to achieve the underlying purposes of such conditions, which purpose is to collect the data necessary to demonstrate that the withdrawal of up to 2000 gallons per minute from the Bullfrog Mine wellfield does not produce effects which impair the water rights of the United States, National Park Service.

**BULLFROG MINE WELLFIELD**

The Bullfrog Mine wellfield will provide as much as 2000 gallons per minute (gpm) water supply for Bond Gold's mining operations. The wellfield will include four or more production wells (Plate I). The final number of wells is dependent on yield of individual wells. Currently, the wells tested have indicated a rating of 300 to 800 gpm each. A contour map showing the projected drawdown from this wellfield was generated using an

estimated 10-year mine life and a 2000 gpm water supply requirement. The results of this analysis were presented in a letter report (Fox to Bingham, July 14, 1988, enclosed, Plate II).

### PRODUCTION WELLS

Presently, four production wells exist in the vicinity of the Bullfrog Mine: Exploration test Wells (ETW) I-4, II-1, II-2, and II-5 (Plate I). The Montgomery-Shoshone Well (MSW) north of the pit will also be used as a production well.

### MONITORING WELLS

Presently, 15 monitoring wells exist in the vicinity of the Bullfrog Mine wellfield and throughout the Amargosa Basin (Table 1). Four additional monitoring wells are proposed, bringing the total to 19 monitoring wells. Most of the wells have been -or will be- converted from abandoned mineral exploration drill holes and will be protected and secured to prevent damage.

North of the wellfield are two monitoring wells (CDH-61 and -72) which have been completed from mineral condemnation holes. South of the wellfield are 13 more monitoring wells : MW-1, -2, and -3; NA-1, -3 and -4; and USGS -1, -2, -3, -4, -5, and -6; and a well at the U.S. Ecology facility (Plate I). These wells are located along the southwestern, central, and southern portions of the basin.

Four additional monitoring wells (MW-4, -5, -6, and -7) are proposed adjacent to, and outside of, the 10-year drawdown cone (Plate II). Wells MW-4 and -5 will be constructed in alluvium, and together with wells MW-1, -2, and -3, will complete a line of monitoring wells between the wellfield and Death Valley (Plate I). They will allow detection of any drawdown which may occur outside the projected drawdown area.

Well MW-6 will be positioned southwest of MW-5, close to the Funeral Mountain range-front (Plate I). This well will be completed in Paleozoic rocks and is designed to monitor any possible alluvium-bedrock, ground-water interactions. The exact location depth and completion for MW-6 will be determined by joint agreement between Bond and NPS.

Well MW-7 will be located in the southeastern portion of the basin near Crater Flat (Plate I). Here, the alluvium is believed to be thin, and therefore, the well may be completed in bedrock beneath the alluvium. This well is also designed to monitor possible alluvium-bedrock ground-water interactions.

Monitoring wells (MW-4, -5, and -7) will be completed to a depth of 700 to 900 feet, as necessary, to allow the perforated casing to penetrate approximately 200 feet of water-saturated geologic material. The wells will be constructed with single-perforated, 6-inch steel casing within a 12-inch borehole. Gravel, filter pack material will be used in the annular space between the casing and the borehole. Casing diameter will be such that the wells can be developed by airlifting and pumped for water samples. One sample will be taken from each well after well construction to document water quality and to aid the in

characterization of regional hydrologic and geochemical conditions. As stated earlier, the exact location depth and completion for MW-6 will be determined by joint agreement between Bond and NPS.

### SPRINGS OF DEATH VALLEY

High discharge springs in the vicinity of Park Headquarters are currently being monitored. However, during a site visit to some of these springs (Texas, Nevares, Travertine) it appears that water use, not spring discharge, is currently being recorded. With only slight modification, the NPS can obtain spring discharge information.

Springs in the northern part of the Monument, some distance west of Bond Gold's wellfield, generally have discharges too low to measure. These springs are likely to be perched, and not connected to the regional ground-water flow system. The group of springs at the Keane Wonder Mine (Spring 186) will be monitored. Staff gages or shallow monitoring pipes will be installed to document the water levels and any water discharge.

### MONITORING PROGRAM

The monitoring program is designed to provide baseline and continuing hydrologic data on ground-water elevations and spring discharges. Initially, the data collection process will enable establishment of the natural hydrologic behavior of the monitoring point from which variations in water levels and spring discharges can be documented.

In order to accurately document seasonal or other systematic water level variations, measurements should begin at relatively frequent intervals (to develop background information on the dynamics of the hydrologic system), and then be decreased to more manageable levels, once a data base has been developed.

At this time, a 12-month data base is expected to allow adequate characterization of natural behavior. Additional inquiry into existing data collection networks (U.S.G.S., State of Nevada, etc.) will be undertaken to determine if any long-term variations in water level are currently recognizable, and which should be incorporated into the characterization obtained from this monitoring program.

#### Monitoring Wells

Production well monitoring will be performed daily by Bond for one month once full utilization of a particular well occurs, at which time the frequency will be reduced to weekly monitoring. Data recorded will include pumping and non-pumping water levels, and instantaneous and cumulative discharge (Table 1).

All other water levels of monitoring wells will be measured monthly by Bond. This monthly schedule should continue for 12 months, data would also be collected monthly at wells MW-4, -5, and -6 for a total of 24 months, afterwhich quarterly monitoring will be instituted. It may be possible for the United States Geologic Survey (USGS) to assist Bond and NPS by temporarily providing automatic recording devices (transducers) which can record water level measurements at predetermined intervals in a number of monitoring

wells. These readings would augment daily or weekly readings and aid in the overall understanding of the ground-water system.

All of the wells will be monitored for a 12-month period to provide adequate background information, after which, the monitoring network will be reduced to thirteen wells, tentatively including: CDH-72, -61; MW-1, -2, -3, -4, -5, -6, -7; USGS-1, -2, -3, and NA-4 (Plate I). Reduction in the number of wells is recommended to avoid oversampling. Many of the wells are located very near to each other and will therefore provide similar or duplicate information. The well in each of the groupings that appears most useful will be designated after the 12-month period. The larger number of wells is useful for the development of the data base, and to document subtle variations in the dynamics of the hydrologic system. However, for long-term monitoring, we believe the reduced number of wells will be adequate to provide sufficient water level monitoring points to accurately define any adverse changes in the ground-water system. Any reduction in monitoring well network would be by mutual agreement between NPS and Bond.

The locations and construction details of all the monitoring wells are listed in Table 2. Criteria for choosing which wells will be included in the final monitoring network has included: 1) ability of the well to provide accurate water level information (ie. penetrate sufficient thickness of saturated material); 2) adequate areal spacing of the wells throughout the basin; and 3) sufficient number of wells completed in alluvium and bedrock. Final determination of the wells to be included in the long-term monitoring program, will be determined by joint agreement between Bond and NPS.

### Spring Monitoring

Monitoring at the high discharge springs near Park Headquarters should be performed by the NPS. Bond will recommend and purchase suitable recording and monitoring equipment for these springs. It will be the responsibility of the NPS to record discharge information and to perform any necessary maintenance and repair of the equipment. Spring discharge measurements should be recorded continuously for 12 months, then reduced to weekly measurements, if appropriate.

Monitoring of low discharge springs or seeps near the Keane Wonder Mine (Spring 186) will be performed monthly. Bond will recommend, purchase, and install staff gages or shallow-monitoring pipes at the springs to facilitate accurate measurements. Monitoring of the springs and maintenance and repair of the equipment will be the responsibility of the NPS.

### QUALITY CONTROL AND QUALITY ASSURANCE

Representatives of Bond Gold and NPS will attend each other's data collection runs at least once in the first six months of data collection to provide feedback and help develop and maintain proper quality assurance and quality control (QA/QC) measures. Data would be exchanged to update the data base of both parties.

Clearly defined monitoring protocol will be established and agreed upon by both parties for recording water levels in wells and discharge rates from springs. Water level

measurement at the monitoring wells will be by electric circuit type sounding device. Other devices were considered (sonic, laser, pressure transducer) but due to field problems (personal communication, Czarnecki, USGS, to King, HSI) associated with misaligned holes or necessity for frequent calibration, the electric circuit type appears at this time to be the best choice. Calibration of the electric sounder with a steel tape would be performed once a month. The calibrated sounding device would be used on all wells. Use of the sounding device would follow manufactures instruction with regard to measuring points, maintenance, etc. Production wells will be equipped to allow measurement of water levels by either electric sounding tube or an air-line/pressure gage setup. Records of water level and spring discharge will be recorded on mutually agreed upon forms.

Water level readings from the close-in monitoring (CDH-61 and -72) and production wells would be used to characterize the initial cone of depression and to document the radius of influence. This would allow pumping to proceed prior to completion of the regional 12-month data base. Data generated during the 12-month period (and from existing data networks) will be used to establish limits within which variations in natural water level, or spring discharge, can be expected to fall. This type of approach should allow for quantitative recognition of any significant change in water level or discharge, in a system that is either stable or experiencing long-term variation.

#### REPORTING AND REEVALUATING

To allow for a convenient and clearly defined data collection schedule, monitoring will be performed on Monday of each week or on the first Monday of the month. The data

collected, weekly or monthly, will be provided to Bond and the Superintendent of Death Valley National Monument within 10 days of the last day of each quarter, or upon the request of either party (March 31, June 30, September 30, and December 31). Semi-annual summaries will be supplied to the State Engineer, Bond, and the Superintendent of Death Valley National Monument. Preparation of these summaries should be undertaken independently by both Bond and the NPS. Additional data currently being recorded (Bond, NPS, other groups) such as precipitation and seismic data would also be tracked (but not necessarily exchanged) in order to assess their potential impact on regional water levels and spring discharge.

The computer model (General Aquifer Analysis {Koch and Associates, 1987} to be provided to NPS) of the predicted 10-year cone of depression surrounding the well field (Plate II) will be updated annually by both parties, utilizing the collected data base. Updated information will include measurements of cumulative discharge, static and pumping water levels from the production wells, and water levels from the surrounding monitor wells. This information will be used to check the accuracy of the initial model, and allow for a re-evaluation of drawdown predictions and an increasing understanding of the hydrologic system. In the event that actual drawdown is significantly greater than that predicted, then the entire hydrologic monitoring program will be re-evaluated to include the up-dated information. This re-evaluation of the monitoring program would represent the next step in additional hydrologic monitoring. Additional wells, age dating of water from wells or springs, etc., are examples of the type of action to be undertaken in the event of significant departure from historic water levels recorded during the life of this

monitoring program. Also, any actual concerns which might arise regarding relationships of spring discharge to Bond pumping activities would undoubtedly require a period of relatively more detailed, site specific investigation of spring hydrology, including recharge characteristics, variations in water chemistry, and similar factors.

This proposed plan is designed to allow both parties to participate and take responsibility for data collection where most appropriate. Review and analysis of the data would be performed by both parties independently. It is the intent of this plan to jointly resolve, where possible, concerns regarding the effects of the operation of the Bullfrog Mine Wellfield. To this end the following is agreed.

If, during the course of wellfield operations one or more of the following occurs:

- 1) there is observed a decrease in discharge from monitored springs of greater magnitude or duration than recorded during the baseline period;
- 2) there is observed an adverse change in the hydraulic characteristics of the water source referred to as the deep and/or Paleozoic aquifer, as measured in the well or wells designed to monitor such aquifer, of greater magnitude or duration than recorded during the baseline period; or
- 3) it is predicted, in simulations using computer algorithms and measured data, that ground water withdrawals, at 10 years from the effective date of the water rights application, will affect NPS water sources;

then the NPS will inform Bond and the Nevada State Engineer of its concern over an imminent and serious impact to Federal reserved and/or State appropriate water rights. Consequent to this action, Bond will have a reasonable period of time, as agreed to by both parties, in which to acquire additional data to support a

contention of no impact attributed by Bond Gold's operations to NPS water sources. If, at the end of the time period agreed to for additional data collection, NPS concerns have not been alleviated, either by analysis of existing data or new information developed by Bond, then Bond will have an opportunity to modify its operations so as to bring water withdrawal into balance with simulated aquifer "no impact" yields. If Bond is unable or unwilling to so modify its ground water withdrawals, then the NPS will advise the Nevada State Engineer that an impasse has been reached and it will request that the State of Nevada protect the water rights of the United States, NPS in Death Valley and/or Devil's Hole National Monuments.

This plan, agreed to by Bond and NPS, constitutes the monitoring plan described in the document titled, National Park Service Position With Respect To The Application For Water Withdrawal In Armagosa Valley By St. Joe Bullfrog, Inc., (Bond Gold), Prepared By The Water Resources Division, September 16, 1988, and referenced by the Nevada State Engineer in conditions to Permits 51841 through 51848 inclusive. As such it meets or supercedes conditions 1 and 2 of the above described document.

Table 1. Proposed Data Collection Schedule, Monitoring Program, Bond Weir Field

Data Point	Frequency of Data Collection	Water Level	Discharge Rate	Cumulative Discharge	Date	Time	Pumping or Non-Pumping	Quality of Water	Frequency of Report to NPS, Bond
I-4	Daily/Weekly	X	X	X	X	X	X	Annual	Quarterly
II-1	Daily/Weekly	X	X	X	X	X	X	Annual	Quarterly
II-2	Daily/Weekly	X	X	X	X	X	X	Annual	Quarterly
II-5	Daily/Weekly	X	X	X	X	X	X	Annual	Quarterly
MSW	Daily/Weekly	X	X	X	X	X	X	Annual	Quarterly
MW-1 to MW-7	Monthly/Quarterly	X			X	X		Initial	Quarterly
U.S. Ecology	Monthly/Quarterly	X			X	X		None	Quarterly
NA-1, NA-3, and NA-4	Monthly/Quarterly	X			X	X		None	Quarterly
USGS-1 to USGS-6	Monthly/Quarterly	X			X	X		None	Quarterly
CDK-72	Monthly/Quarterly	X			X	X		None	Quarterly
CDK-61	Monthly/Quarterly	X			X	X		None	Quarterly
Major Springs	Weekly/Monthly	X	X	X	X	X		Annual	Quarterly
Keane Wonder Mine Springs	Monthly/Quarterly	X	X	X	X	X		Initial	Quarterly

Note:

1. Frequency of data collection based on ability to adequately characterize pumping and non-pumping water levels and spring discharge, and is subject to change according to results obtained.
2. Water quality to cover major cations and anions.

Table 2. Record of Wells for Proposed Hydrogeologic Monitoring Network

Well Designation	Location	Owner	Surface Elevation	Height of Measuring Point (ft)	Depth to Water	Ground Water Elevation	Well Depth (feet)	Casing Depth (feet)	Casing Diameter (inches)	Screened and Perforated Interval (ft)	Measurement Date
NA-1	13S 46E 34ACCC	USGS	3230	0.0	244	2996	1500	321	8.0	---	1/11/87
NA-3	13S 46E 35A0DD	USGS	3040	0.0	417	2623	1180	470	8.0	---	1/11/87
NA-4	12S 46E 15D8E8	USGS	3130	2.0	503	2629	1500	500	2.0	---	12/2/88
USGS-1	13S 46E 31BAD	?	3760	0.0	475	3225	475	475	6.0	---	10/30/86
USGS-2	13S 47E 33BACC	USGS	2820	---	343	2477	402	402	---	382-402	6/9/83
USGS-3	13S 47E 35BDB	USGS	2775	---	359	2416	414	414	---	285-295	2/27/85
USGS-4	14S 46E 26BA	USGS	2720	0.0	282	2438	1880	1400	7.0	1380-1850	1/11/87
USGS-5	14S 46E 25AA	USGS	2705	2.7	305	2400	1898	1850	2.0	1830-1850	1/11/87
USGS-6	14S 46E 26AA	USGS	2710	0.9	303	2438	1920	1900	2.0	1880-1900	1/11/87
U. S. ECOLOGY	13S 47E 35BAD	U. S. ECOLOGY	2788	0.5	282	2506	573	575	8.0	435-493	1/7/87
MI-1	14S 47E 32DAC	?	2625	1.7	267	2358	950	914	2.0	894-914	12/5/88
MI-2	14S 46E 23CB	?	2750	0.0	282	2468	?	?	7.0	---	11/11/88
MI-3	14S 46E 08B8DD	USGS	3220	2.3	365	2855	733	380	3.0	360-380	12/3/88
MI-4*	13S 46E 10DB	BOND GOLD	3170								
MI-5*	13S 46E 16AD	BOND GOLD	3200								
MI-6*	13S 45E 24CD	BOND GOLD	3580								
MI-7*	14S 48E 30CD	BOND GOLD	2580								
I-4	12S 46E 27CC	BOND GOLD	3280	2.0	618	2662	1083	1082	16.0	680-998	8/13/88
									12.0	1015-1045	
									10.0	1031-1082	
II-1	12S 46E 33DA	BOND GOLD	3280	2.0	719	2561	1205	1200	16.0	708-1200	8/8/88
II-2	12S 46E 35CB	BOND GOLD	3160	2.0	607	2553	1410	1348	16.0	533-984	10/28/88
									10.75	1029-1089	
										1109-1329	
II-5	13S 46E 03BC	BOND GOLD	3220	2.0	687	2533	1450	1420	16.0	677-1400	12/5/88
CDH-72	12S 46E 16DD	BOND GOLD	3531	0.82	470	3061	755	770	1.0	629-755	6/18/88
CDH-61	12S 46E 22AC	BOND GOLD	3331	1.66	681	2650	1000	985	1.0	383-985	6/18/88

NOTE: 36BAD = Sec. 36, NW1/4, NE1/4, SE1/4

\* Proposed well

Data source: USGS, Carson City, Nevada, and Bond Gold well logs