RESNA

Working to Restore Nature

42501 Albrae Street
Fremont, California 94538
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92 OCT 10 PM 2:33

October 8, 1992

Ms. Juliet Shin
Hazardous Material Specialist
Alameda County Health Care Services Agency
80 Swan Way, Room 200
Oakland, California 94621

Subject: Pump Test Report and
Canal Sample Results

Site: Crown Metals
16525 Worthley Avenue, San Lorenzo, California

Dear Ms. Shin:

As requested, RESNA Industries Inc., is submitting on behalf of Crown Metals, the Pumping Test and Aquifer Evaluation Report, and Canal Sample Results for the subject site. A site plan showing the location of the sample collection points is attached (Figure 2).

The Pumping Test and Aquifer Evaluation Report indicate the recovery wells radius of influence is adequate to contain dissolved hydrocarbons on-site. The sample results from the canal reported non-detectable for purgeable hydrocarbons and BTEX.

Sincerely,
RESNA Industries Inc.

Gary Pischke, C.E.G. 1501
Project Manager

GP/sr
Attachment

Working To Restore Nature

3164 Gold Camp Drive
Rancho Cordova, CA 95670
Phone: (916) 852-6690
Fax: (916) 852-6688

PUMPING TEST AND AQUIFER EVALUATION

Crown Metals-Pacific International Steel Facility
16525 Worthley Drive
San Lorenzo, CA

Russell W. Juncal
CA Registered Geolgist no. 3864

September 22, 1992

1.0 Purpose and Scope

RESNA Industries conducted a series of constant-rate pumping tests at the site to evaluate hydrologic and well conditions and provide baseline information for the possible design and operation of a ground-water remedial system. The testing program comprised three separate elements designed to provide different types of information. The first element consisted of a period of static ground-water monitoring. These data were used to establish initial conditions and to aid the evaluation of the significance of water-level changes observed during the later pumping test.

The second element of the test program consisted of three short-term constant-rate tests using well RW-1. This series of tests provided information regarding the well productivity and efficiency. The tests were also used to select the rate for the longer-term constant-rate pumping test which constituted the third element of the testing program.

The long-duration, constant-rate pumping test utilized well RW-1 for production and wells MW1, MW2, MW4, MW-5, MW-6, and MW-7 as observation wells. Data from this test were used to evaluate the hydraulic parameters transmissivity (T) and specific yield (S_y) and to provide information regarding aquifer boundary conditions and anisotropy.

2.0 Test Instrumentation and Format

The production well RW-1 was outfitted with a 4-inch submersible pump which was plumbed through a gate valve and flow meter to a 21,000-gallon storage tank onsite. The discharge rate was controlled and recorded manually.

Drawdown in the pumping well and in observation wells MW-1, MW-2, and MW-4 was recorded both manually with a conductivity probe and automatically using a data pressure/logger transducer system. The drawdown in wells MW5, MW6 and MW7 was only recorded manually.

During the first portion of the test program, static water levels in wells RW-1, MW1, MW-2 and MW-4 were monitored for approximately 12 days. This monitoring was conducted to evaluate short term fluctuations in the shallow aquifer under non-pumping conditions.

The second phase of the test program consisted of there short-duration constant-rate tests at approximately 1.5, 2.0 and 2.5 gallons per minute (gpm). The pumping duration of these tests ranges from 20 to 46 minutes. The well was allowed to recover completely between each test. The projected drawdown at 20 minutes elapsed pumping time for each test was used to calculate well productivity in gpm per foot of drawdown (gpm/ft). The reciprocal of productivity, specific drawdown (ft/gpm), is plotted versus the pumping rate for the three short-term tests and the longer term test on Figure 1. This plot is discussed in further detail in the following sections.

The long-term test entailed pumping from well RW-1 approximately 1760 minutes while monitoring drawdown in wells MW-1, MW-2, MW-4, MW-5, MW-6 and MW-7. At the end of the pumping period, partial recovery of well RW-1 was monitored. Semilog plots of the drawdown versus time for wells RW-1, and MW-2 are shown as Figures 2 and 3. Data from the other wells were not plotted because observed drawdown was small and largely obscured by tidal effects.

A plot of the monitoring well drawdowns after 1760 minutes of pumping versus the log of their distance to the pumping well is shown on Figure 4.

3.0 Background Water Level Monitoring

The static monitoring component of the test program consisted of placing pressure transducers into wells RW-1, MW-1, MW-2 and MW-4 for approximately 12 days before initiating pumping.

The data from well RW-1 show a regular 6 hour (approximately) fluctuation of water elevation related to the tidal cycle. The magnitude of water level change over a tidal cycle varied during the monitoring perioid but ranged from approximately .35 to .6 feet. These fluctuations are clearly seen on the plot of drawdown in well RW-1 during the pumping test (Figure 2), however, they do not obscure the trend related to pumping. The data were not corrected for tidal effects.

4.0 Results of Short-Duration Tests

The short-term constant-rate tests showed very little decline in well productivity (pumping rate/ft of drawdown) with increasing discharge rate. The specific drawdown s/Q (feet of drawdown/gpm) is plotted versus the pumping rate (gpm) for the 1.5, 2.0 and 2.5 gpm short-term tests and the 1.0 gpm longer-term test on Figure 1.

The data plotted on Figure 1 were used to evaluate the well performance. The drawdown in a pumped well consists of two components, the aquifer losses and the well losses. The aquifer losses are generally related to laminar flow conditions and vary linearly with the pumping rate. The well losses include head loss which varies both linearly and non-linearly with well discharge rate. The linear well losses are generally related to aquifer damage during well construction. The non-linear (non-darcy) well losses are related to turbulent flow within the well screen, the discharge pipe, and the formation.These two components can be characterized by the following equation:

$$s = AQ + BQ^{P} \qquad \text{(Equation 1)}$$

where:

AQ	=	linear head loss
BQ	=	non-linear head loss
s	=	drawdown at a given time
Q	=	discharge rate
P	=	a discharge rate dependent value between 1.5 and 3.5

A and B are constants

A value of 2 for P is commonly accepted in this equation (Ramey, 1982), which yields the equation:

$$s = AQ + BQ^2 \quad \text{(Equation 2)}$$

or dividing by Q

$$s/Q = A + BQ$$

The latter equation represents a straight line on an s/Q versus Q plot (Figure 1). Using the approach of Jacob as outlined in Todd (1980), the data indicate an insignificant non-darcy (non-linear) component of the drawdown. A further indication of the relatively low well losses was indicated by the water level recovery in well RW-1 after pumping was halted. The water level showed a relatively slow, even recovery over the first 60 minutes (as opposed to a very rapid buildup after the pumping is ceased) which is characteristic of wells with limited wellbore and near-wellbore head losses due to turbulent flow.

The least squares best fit line shown in Figure 1 yields the following relationship between drawdown and pumping rate:

$$s = 1.59Q + 0.035Q^2$$

Using the coefficients (A and B) calculated from the best fit line shown on Figure 1, the well efficiency can be calculated for various times and pumping rates. Using the 20-minute drawdown data shown, the well efficiency at 1.0 gpm is approximately 98 percent. This efficiency is similarly indicated on the drawdown versus distance from the pumping well plot (Figure 5). When the trend line of this plot is extrapolated to a distance of approximately 0.25 feet (outer edge of casing), the expected drawdown (formation loss only) is approximately 1.5 feet. This interpretive approach indicates a well efficiency of approximately 30 percent.

Low well efficiencies are common in unconfined aquifers when drawdown encompasses a significant portion of the saturated screen thickness. This is due to the partial penetration effect which induces vertical flow gradients in the vicinity of the well screen. The range of values calculated for RW-1 from the two different analytical approaches indicates a reasonably efficient well.

5.0 Results of Long-Duration Constant Rate Test

Because the total drawdown in the pumping well (RW-1) was relatively small and a portion of the drawdown during the long term test was due to well loss, the actual drawdown in the formation away from the production well was small. This is clear from the observation well drawdown versus time plot for the closest monitoring well, MW-2, (Figure 3) which showed a total drawdown of only .25 feet. The maximum drawdown (uncorrected for tidal influence) recorded in the monitoring wells ranged from 0.0 feet in well MW-7 (217 feet from well

RW-1) to .25 feet in well MW-2 (84 feet from well RW-1). The small maximum water elevation change was unexpected and is inconsistent with the background data collected under static conditions which showed tidal cycle variations of up to .7 feet.

The drawdown in wells RW-1 and MW-2 are plotted versus the log of pumping time (semi-log plot) on Figures 2 and 3. Figure 4 presents the drawdown in wells MW-1, MW-2, MW-4, MW-5, MW-6, and MW-7 after 1760 minutes of pumping versus their respective distances from the pumping well (RW-1).

Table 1 shows the transmissivity and storage coefficient values calculated from these plots using the methods of Copper and Jacob (1946).

The transmissivity value calculated from the production well RW-1 drawdown data is probably not representative (too low) due to the effects of partial penetration. The calculated transmissivity values from the well MW-2 data and the distance/drawdown data are reasonably consistent and are probably most representative of the aquifer conditions experienced during the test. These values are also consistent with the lithologies observed during drilling (silts/clays).

The specific storage values calculated from the test data are low and also consistent with the observed lithology.

No boundary conditions could be identified in the test data, however, it is possible that a recharge boundary may have been obscured by the tidal affect. A channel that runs along the southern boundary of the property at a distance of approximately 110 feet may be in hydraulic communication with the shallow groundwater system. From Figure 4 it is clear that the channel is within the radius of influence of the pumping well. ?

6.0 Zone of Capture

An estimate of the steady state downgradient limit of an extraction well capture zone can be made using the following equation:

$r_c = Q/2\pi Ti$, where

r_c = limit of capture zone downgradient of a pumping test well (point where pumping induced ground-water velocity equals the natural velocity),

Q = pumping rate

T = average transmissivity (.14 ft^2/min)

i = average ground-water gradient magnitude (.007)

For extraction of 1.0 gpm from well RW-1 and average values of T and i based on data collected during the pumping test,

r_c = 22 feet

This represents the capture zone immediately downgradient of the pumping well. At 90 degrees (directly crossgradient) to RW-1 the limit of the capture zone would be approximately 140 ft.

6.0 Conclusions

The analyses of pumping test data from the site yields the following conclusions:

- o The water-bearing zone from approximately 5 to 15 feet below grade is heterogeneous, anisotropic, and unconfined.
- o The transmissivity of this zone is approximately 0.14 ft^2/min and the specific yield is approximately 3 percent.
- o The production well did not exhibite large non-linear head losses and had reasonable efficiency.
- o The limit of the steady state capture zone downgradient of pumping well RW-1 is approximately 22 feet. The width of the steady state capture zone is approximately 70 feet.

TABLE 1
CALCULATED AQUIFER HYDRAULIC PARAMETERS
Crown Metal Manufacturing Facility
16525 Worhtley Drive
San Lorenzo, California

Well	Analytical Method	T	S_y
RW1	CJs	0.075	-
MW-2	CJs	0.12	.003
MW-1,2,4,5,6,7	CJr	0..16	002

T = Transmissivity (ft^2 /min)
S_y = Specific yield

CJs = Cooper - Jacob drawdown versus time method (1946)

CJr = Cooper - Jacob drawdown versus distance method

FIGURE 1. Well Loss Analysis (Jacob method) for well RW-1

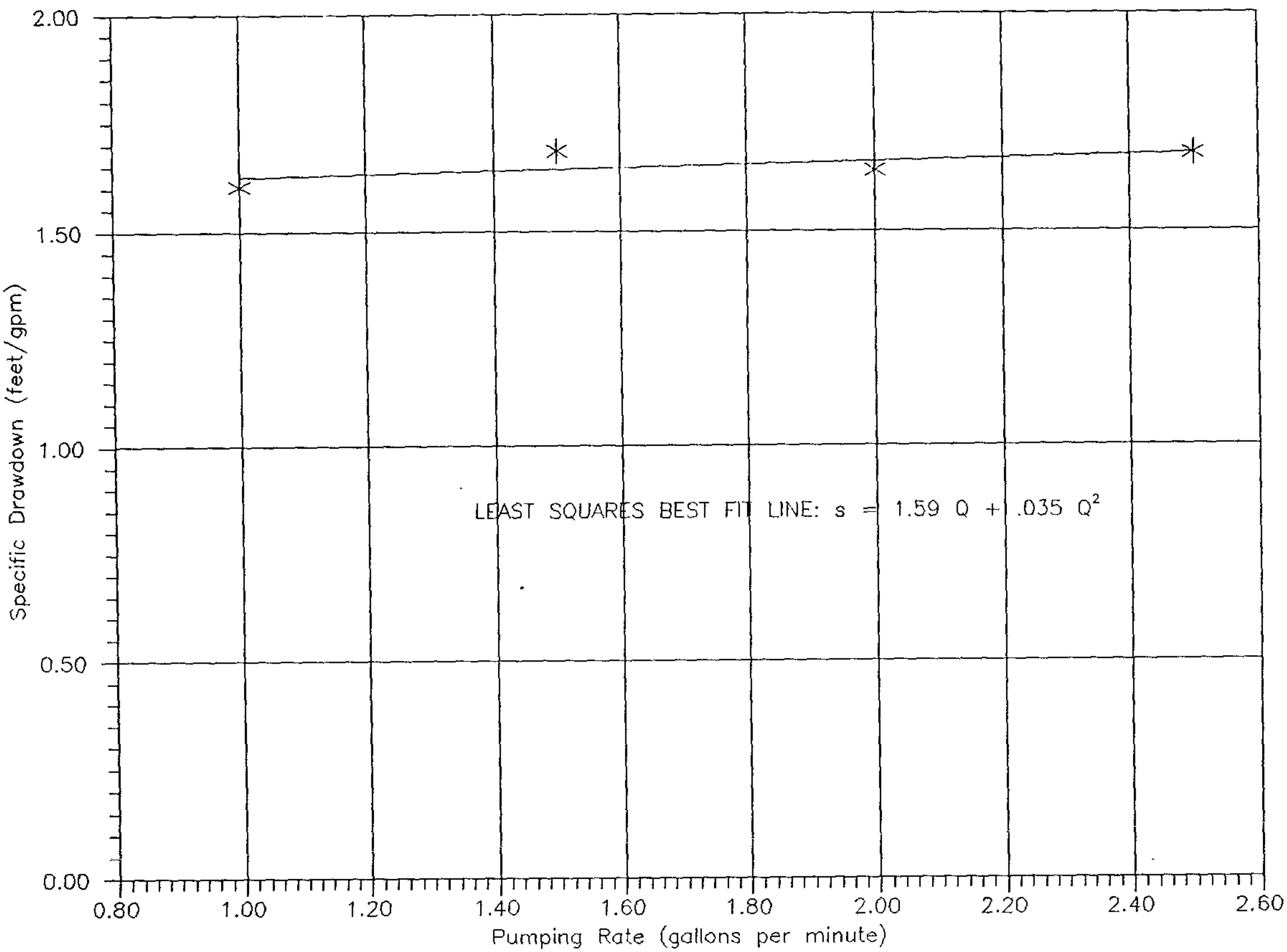


FIGURE 2. Depth to water versus time during 1.0 gpm test - Well RW-1

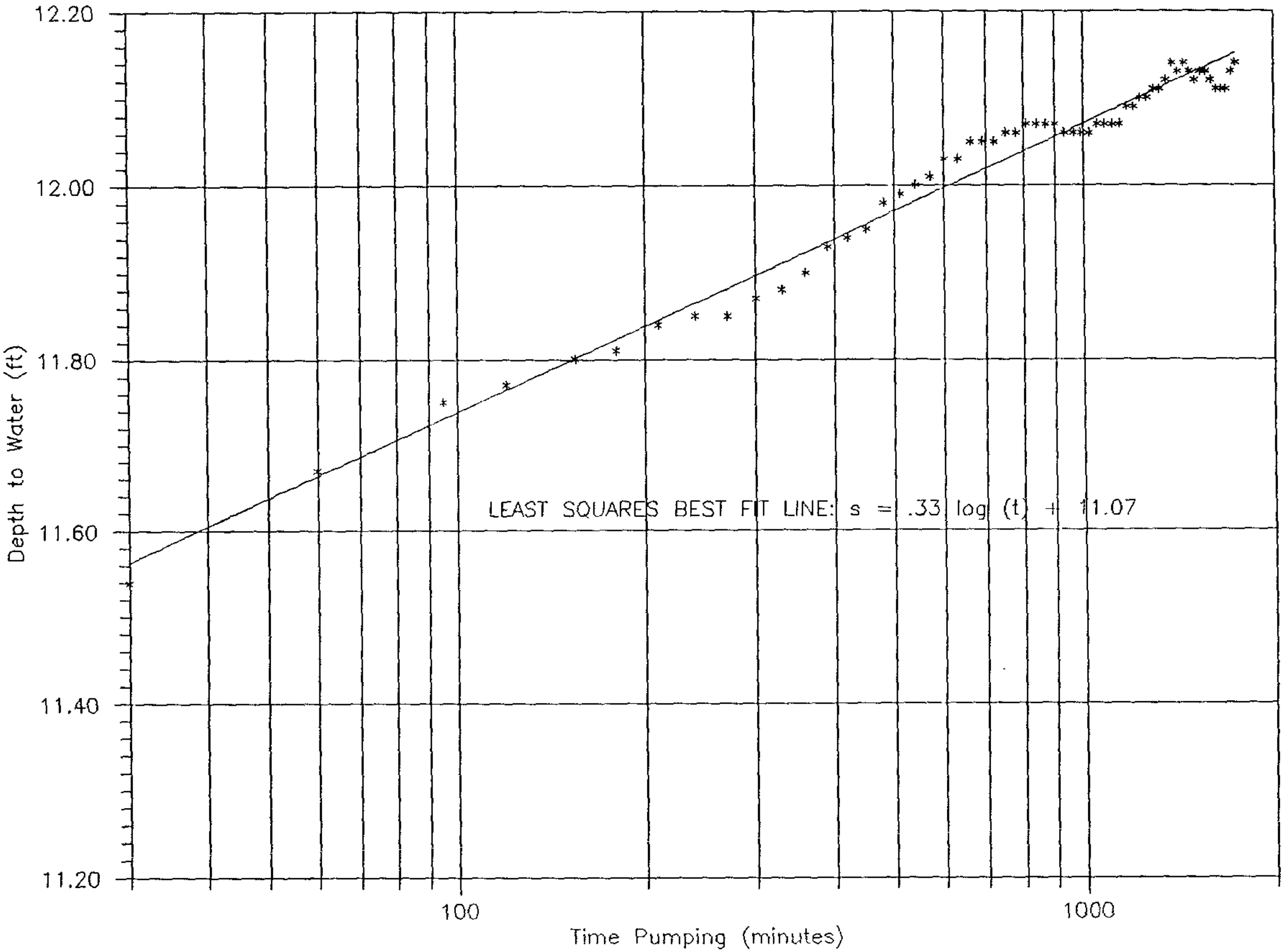


FIGURE 3. Depth to water versus time during 1.0 gpm test – Well MW-2

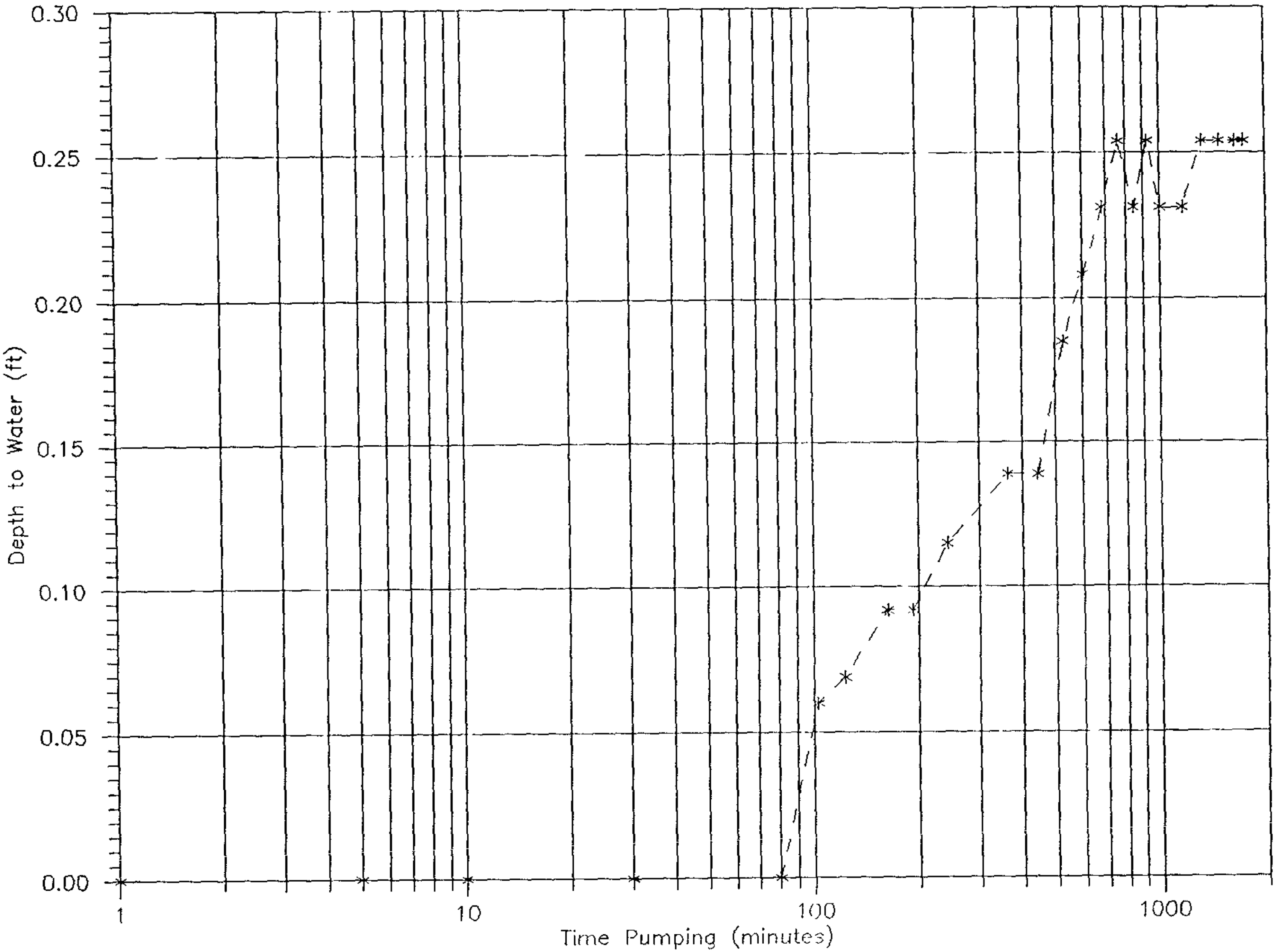
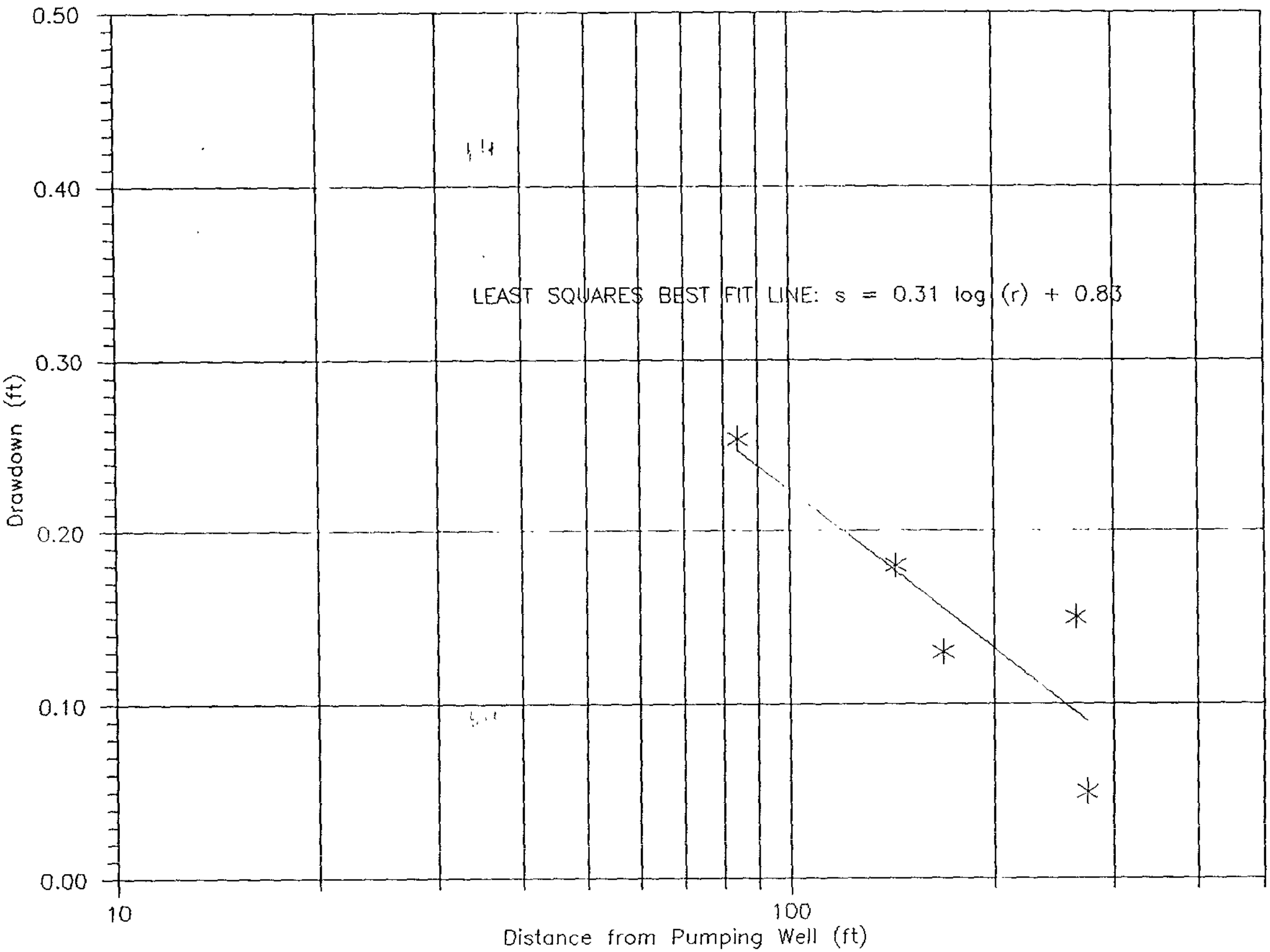


FIGURE 4. Drawdown versus distance from pumping well



SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

RESNA	Client Project ID: 3462-2, Crown Metals	Sampled:	Sep 17, 1992
42501 Albrae Street, Suite 100	Sample Matrix: Water	Received:	Sep 18, 1992
Fremont, CA 94538	Analysis Method: EPA 5030/8015/8020	Reported:	Sep 24, 1992
Attention: John Turney	First Sample #: 209-2996		

TOTAL PURGEABLE PETROLEUM HYDROCARBONS with BTEX DISTINCTION

Analyte	Reporting Limit µg/L	Sample I.D. 209-2996 Upstreams	Sample I.D. 209-2997 Downstreams
Purgeable Hydrocarbons	50	N.D.	N.D.
Benzene	0.50	N.D.	N.D.
Toluene	0.50	N.D.	N.D.
Ethyl Benzene	0.50	N.D.	N.D.
Total Xylenes	0.50	N.D.	N.D.
Chromatogram Pattern:		--	--

Quality Control Data

Report Limit Multiplication Factor:	1.0	1.0
Date Analyzed:	9/23/92	9/22/92
Instrument Identification:	GCHP-7	GCHP-7
Surrogate Recovery, %: (QC Limits = 70-130%)	78	90

Purgeable Hydrocarbons are quantitated against a fresh gasoline standard.
Analytes reported as N.D. were not detected above the stated reporting limit.

SEQUOIA ANALYTICAL

Maria Lee
Maria Lee
Project Manager

2092996.EN8 <1>

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

RESNA
42501 Albrae Street, Suite 100
Fremont, CA 94538
Attention: John Turney

Client Project ID: 3462-2, Crown Metals
QC Sample Group: 2092996-7

Reported: Sep 24, 1992

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	R. Lee	R. Lee	R. Lee	R. Lee
Reporting Units:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Sep 22, 1992	Sep 22, 1992	Sep 22, 1992	Sep 22, 1992
QC Sample #:	GBLK092292	GBLK092292	GBLK092292	GBLK092292
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10	10	10	30
Conc. Matrix Spike:	9.5	9.5	9.4	28
Matrix Spike % Recovery:	95	95	94	93
Conc. Matrix Spike Dup.:	9.4	9.5	9.4	29
Matrix Spike Duplicate % Recovery:	94	95	94	97
Relative % Difference:	1.1	0.0	0.0	3.5

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Maria Lee
Maria Lee
Project Manager

% Recovery:	(Conc. of M.S. - Conc. of Sample) / Spike Conc. Added	x 100
Relative % Difference:	(Conc. of M.S. - Conc. of M.S.D.) / ((Conc. of M.S. + Conc. of M.S.D.) / 2)	x 100

2092996.ENS <2>

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

RESNA
42501 Albrae Street, Suite 100
Fremont, CA 94538
Attention: John Turney

Client Project ID: 3462-2, Crown Metals

QC Sample Group: 2092996-7

Reported: Sep 24, 1992

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	B. Ali	B. Ali	B. Ali	B. Ali
Reporting Units:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Sep 23, 1992	Sep 23, 1992	Sep 23, 1992	Sep 23, 1992
QC Sample #:	GBLK092392 MS/MSD	GBLK092392 MS/MSD	GBLK092392 MS/MSD	GBLK092392 MS/MSD
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10	10	10	30
Conc. Matrix Spike:	9.3	9.2	9.9	28
Matrix Spike % Recovery:	93	92	99	93
Conc. Matrix Spike Dup.:	9.3	9.3	9.9	27
Matrix Spike Duplicate % Recovery:	93	93	99	90
Relative % Difference:	0.0	1.1	0.0	3.6

SEQUOIA ANALYTICAL

Maria Lee

Maria Lee
Project Manager

% Recovery: $\frac{\text{Conc. of M.S. - Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$

Relative % Difference: $\frac{\text{Conc. of M.S. - Conc. of M.S.D.}}{(\text{Conc. of M.S. + Conc. of M.S.D.}) / 2} \times 100$

2092996.ENS <3>

RESNA

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

PROJECT NO.	PROJECT NAME/SITE	P.O. #:
3462-2	CROWN METALS	

SAMPLERS (SIGN) Robin A. Adair / (PRINT) Robin A. Adair

ANALYSIS REQUESTED

SAMPLE IDENTIFICATION	DATE	TIME	COMP	GRAB	PRES. USED	ICED	NO. CONTAINERS	SAMPLE TYPE	BTEX (602/8020)	TPHg (8015)	TPHd (8015)	TOG 418.1/5520	601/8010	624/8240	625/8270						REMARKS
Upstream S.	9-17-92	3:00			HCL	Y	3	H₂O	X	X											
DownStreams.	9-17-92	3:15			HCL	Y	3	H₂O	X	X											

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:
Robin A. Adair	9-18-92	7:00AM	[signature]
[signature]	9/18/92	1500	Rebekah J. [signature]
			RECEIVED BY LABORATORY

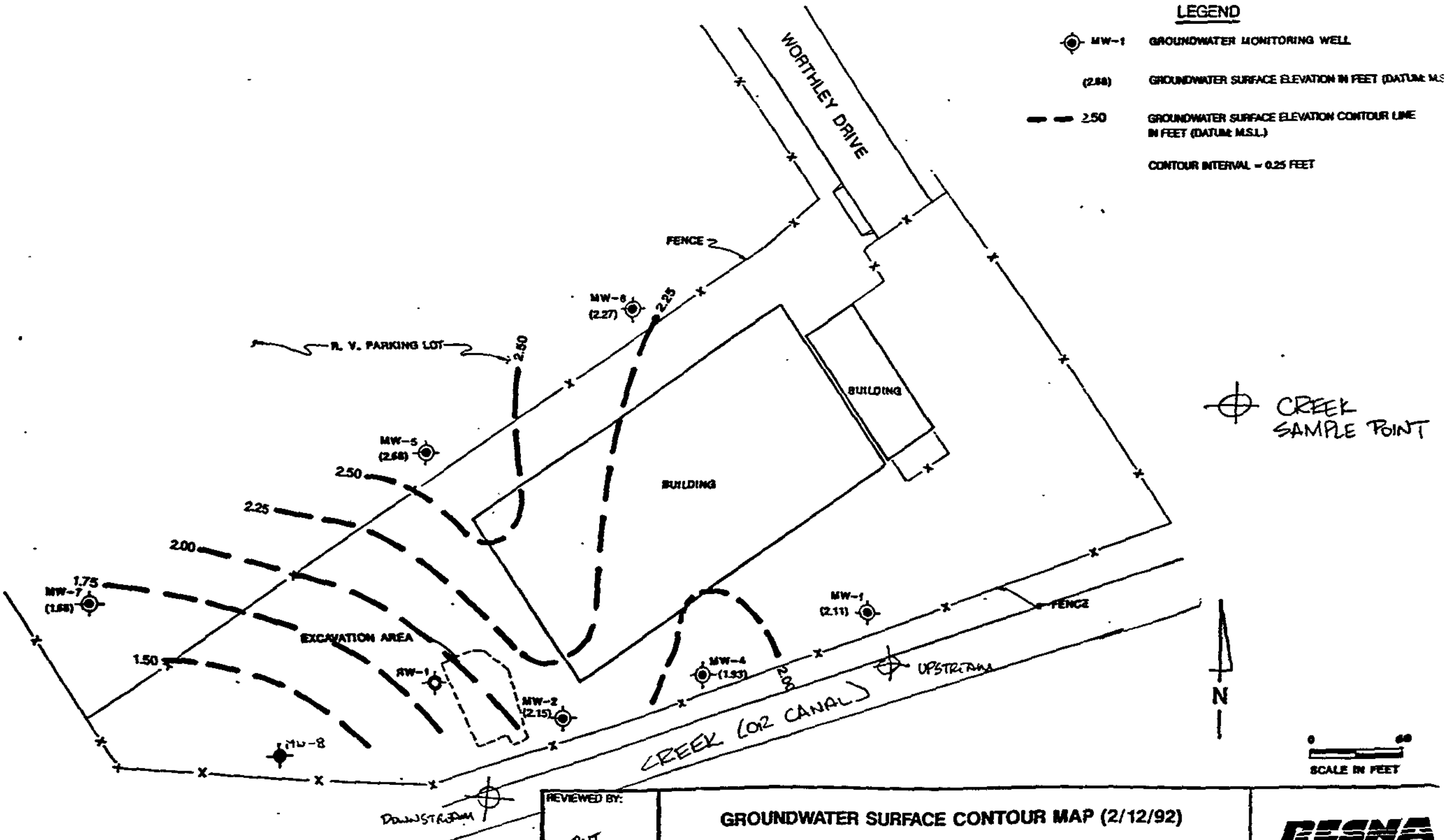
LABORATORY: SEQUOIA

PLEASE SEND RESULTS TO: John Turney, Resna, Fremont. ASAP

REQUESTED TURNAROUND TIME: 5 DAY

RECEIPT CONDITION:

PROJECT MANAGER: " "



REVIEWED BY: BVT	GROUNDWATER SURFACE CONTOUR MAP (2/12/92)	RESNA	
	CROWN METAL MFG – PACIFIC INTL' STEEL		
APPROVED BY:	16525 WORTHLEY DRIVE	JOB #: 1587-2G	DRAWN BY: SLS
	SAN LORENZO, CALIFORNIA	DATE 3/27/92	DRAWING #: FIG. 2