DESERT SPRINGS WATER SYSTEM MONITORING WELLS 5 AND 6 CONSTRUCTION

JULY 1997

WASHOE COUNTY

DEPARTMENT OF WATER RESOURCES

UTILITY SERVICES DIVISION

4930 ENERGY WAY RENO, NEVADA 89502

Department of Water Resources

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MONITORING WELLS 5 AND 6
CONSTRUCTION

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Prepared by:
County of Washoe
Department of Water Resources
Utility Services Division
P.O. Box 11130
Reno, NV 89520

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TABLES AND FIGURES

Summary

The Spanish Springs Village subdivision service area has increased beyond the current peak day production well capacity of the Desert Springs Water system. The water system is operated by the Washoe County Department of Water Resources, Utility Services Division. At least one 500+ gallon per minute(gpm) production well is needed to increase system supply. The targeted well capacity is obtainable, however water quality problems in the west valley area limit suitable production well sites. Water quality problems in the alluvial aquifer were identified as a result of the construction and testing of monitoring wells in 1993 for the water resource study "Hydrogeology and Simulated Effects of Urban Development on Water Resources of Spanish Springs Valley" prepared by the United States Geological Survey (USGS). Initial sampling showed ground water in several west side monitoring wells exceeded the State of Nevada primary and secondary drinking water maximum contaminant levels(mcl) for arsenic(As) and nitrate(NO^3 -N). Two monitoring wells were constructed to find a production well site which met the following requirements; sufficient well yield with As, NO^3 levels and total water quality that met drinking water standards. Figure 1 is a map showing DSMW5, DSMW6 and nearby County monitoring and production wells.

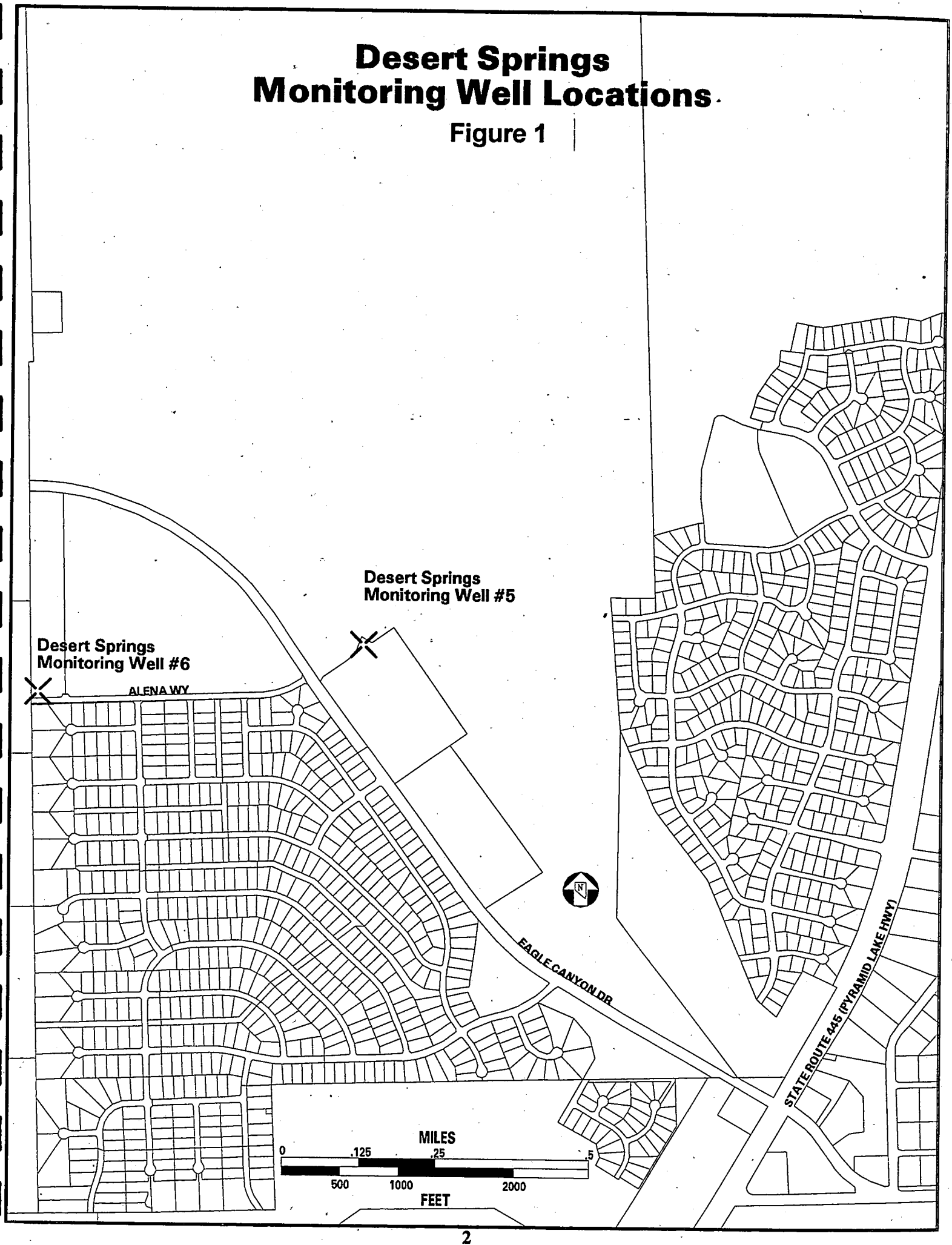
Lang Exploratory Drilling of Elko, NV started the drilling project on January 9, 1997 and completed well construction on January, 21 1997. The wells were drilled by the dual tube, reverse air method. Monitoring well DSMW5 was drilled east of Alena Way on Washoe County School District property and DSMW6 was drilled northwest of Spanish Springs Village, Unit 7 on HAWCO property. DSMW5 was drilled to a depth of 680 feet and constructed to a total depth of 670 feet. DSMW6 was drilled to a depth of 610 feet and constructed to a total depth of 525 feet. Water quality samples for As and NO^3-N were collected from DSMW5 at borehole depths of 180, 410, 580 and 680 feet. NO^3-N concentrations ranged from 1-4 parts per million(ppm) and arsenic concentrations ranged between 0.08-0.18 ppm. Water quality samples for As and NO^3-N were collected from DSMW6 at borehole depths of 200, 260, 340, 400, 460 560 and 610 feet. NO^3-N concentrations ranged from 0-0.3 parts per million(ppm) and As concentrations ranged from 0.60-0.12 ppm. Formation water temperature ranged between 60-100 degrees Fahrenheit (°F) in both wells. Well yield for each well ranged from 50-200 gpm per sample.

The drilling project identified two sites that meet two of the three criteria necessary for production well construction; satisfactory well yield and nitrate levels that meet State of Nevada drinking water standards. Arsenic levels in both wells exceeded maximum contaminant levels throughout the borehole. The potential yield of the wells and the urgency for increased well capacity in the Desert Springs Water System prompted investigation of alternatives for water quality enhancement and arsenic removal at each site. PROSYS Corporation was contacted about arsenic removal since they are experienced in designing arsenic removal systems for high volume well systems. PROSYS suggested implementing a pilot testing program for arsenic removal at one of the monitoring wells. The pilot testing program was not pursued due to the program cost of approximately $22,000.00.

Monitoring well DSMW5 has the potential for a shallow production well from 0-230 feet and a deep production well from 0-660 feet. Estimated well yield for the shallow well is 200-300 gpm and 500+ gpm for the deep well. An advantage of a shallow production well is the temperature of

Desert Springs Monitoring Well Locations

Figure 1



well discharge will be kept below 70 degrees °F, which allows better mixing with lower temperature water in the existing Desert Springs system. DSMW6 could be completed as a 600 foot production well with an estimated well yield of 500+ gpm.

At the time of monitoring well completion, the potential for a long term water exchange agreement between Westpac Utilities and the County for wholesale water purchase and delivery to Spanish Springs Valley is being pursued by both entities. Construction of new production wells, especially in areas where water quality is a concern, is not a option that is currently proposed by staff. Production well construction can always be considered in the future when or if a wholesale agreement reaches completion.

Drilling Operations

Monitoring well construction was done by Lang Exploratory Drilling of Elko, NV. A Lang modified, top head drive, air rotary drilling rig was used for borehole drilling. 6 1/4 inch boreholes were drilled at each well using the dual tube, reverse air rotary method. The boreholes were drilled with tri-cone chisel or button bits. The dual tube drilling method was selected since it allows at point collection of formation samples with minimal circulation of borehole cuttings. The method also allowed instantaneous well yield approximation of a selected zone of the borehole and discrete formation water sampling with minimal mixing or circulation from previously drilled zones. Rapid drilling rates can be achieved with this method with the slowest day of drilling producing 300 feet of borehole.

The drilling fluid consisted of potable water from the Desert Springs Water System and Baroid Quik-Foam foaming agents. When it became necessary to clean the borehole of accumulated cuttings, the density of the drilling fluid was increased using E-Z Mud synthetic organic polymer. Twice during drilling of DSMW5 Baroid Qik-Gel high yield, bentonite clay was mixed with clean water in a portable mud pit in order to drill through saturated, fine sand layers. A cyclone splitter was used to discharge drilling fluid, formation water and remove borehole cuttings. All borehole samples were collected at the discharge end of the cyclone splitter.

Formation samples were collected during borehole drilling at five foot intervals with samples bagged and labeled a minimum of every ten feet or at a major formation change. Borehole geophysics logging of both wells was done by Welenco, Bakersfield, CA. A guarded resistivity, long and short normal electric log, spontaneous potential and caliper log were originally specified for each well. Long and short normal electric were the only logs done at DSMW6 because of Welenco equipment failure. A natural gamma log was added to the contracted work by Welenco at DSMW5 as an exchange for the equipment failure at DSMW6. Water quality and formation sampling, well design and construction supervision were done by Washoe County Utility Services Division (WCUSD) personnel.

Well Construction

The monitoring wells were constructed using 2-1/2 inch black steel pipe with steel caps threaded on the bottom. Perforated pipe with three 3/32" X 3" inch double mill slots per foot was used in each

well. All pipe joints were connected using threaded couplings. All wells were installed with a gravel envelope consisting of well rounded, siliceous 1/4" X 1/8" gravel supplied by Silica Resources Inc., Auburn, California. Neat cement sanitary seals were installed with a grout pump and tremmie pipe. A six inch diameter protective casing and locking cap were cemented in place at each well head.

All monitoring wells were developed by air after the sanitary seals had hardened for a minimum of 12 hours. Well development was accomplished using the drilling rig air compressor to blow high velocity air through a one inch steel development line with a five foot perforated development tool attached to the bottom. The slotted interval of each well was developed by surging in 10-20 foot sections until clear discharge was produced. A well construction summary is found in Table 1.

Well	Total Depth Feet	Cased Depth Feet	Blank Interval Feet	Slotted Interval Feet	Static W. L. Feet below m.p.	Seal Depth Feet
DSMW5	680	672	462	210	34.46	130
DSMW6	620	525	273	252	77.20	100

Table 1
Well Construction Summary

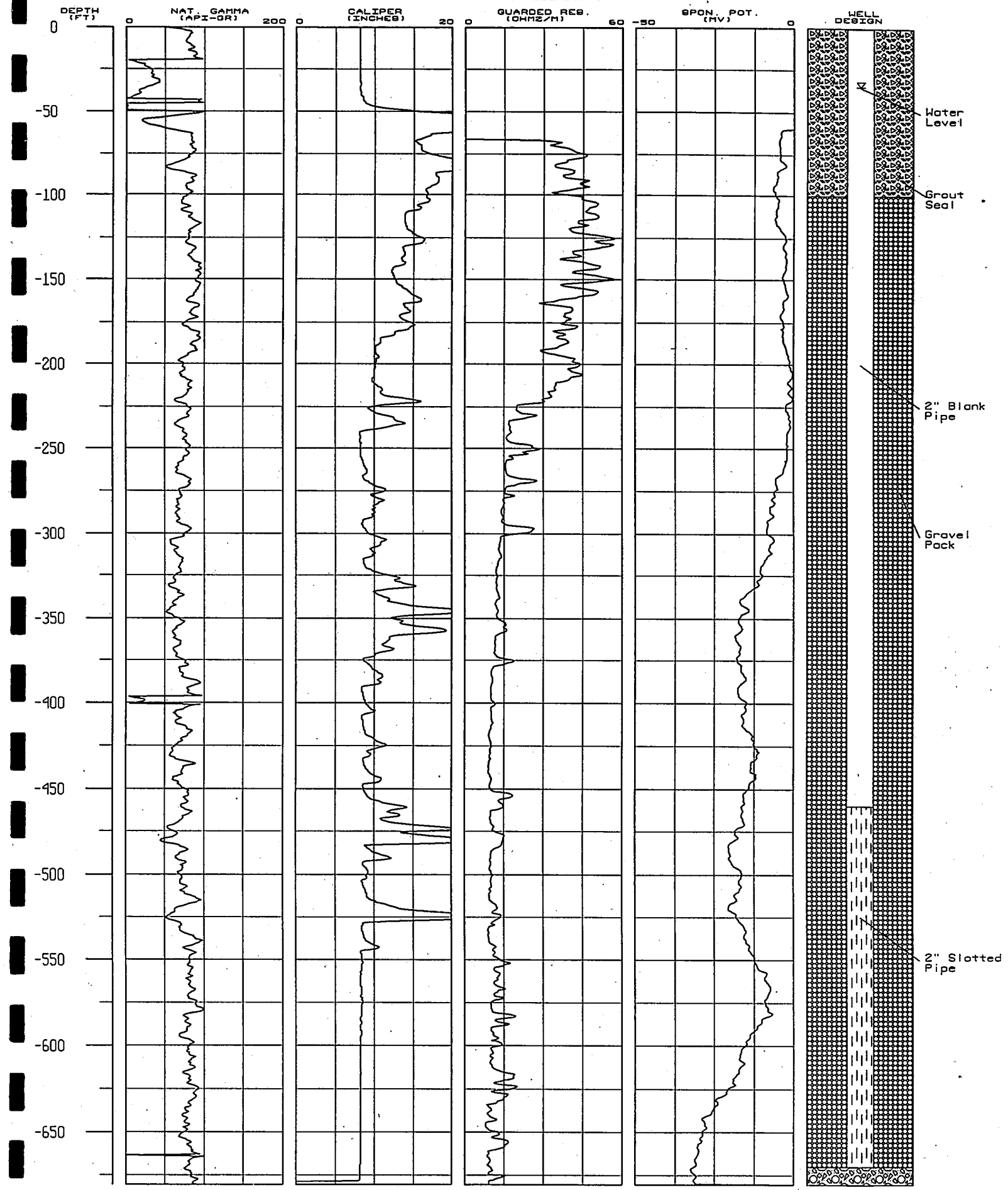
The monitoring wells were drilled in valley basin fill comprised of alluvium and lacustrine sediments. Bedrock was not encountered in either well. The boreholes were continuously sampled and logged by WCUSD personnel. Well driller's reports for each well are in the appendix.

DSMW5

Alluvium containing sub-rounded, moderate to well sorted granitic sand with intermittent small, sub-angular to sub-rounded mafic, volcanic gravel stringers was drilled from 0 to 224 feet. Sample volume of gravel where encountered was 10-30%. Pliable, sticky blue and gray lacustrine clay was drilled from 225 to 450 feet. Fine to medium grained, moderately sorted and rounded andesite sand with intermittent silty clay and volcanic gravel lenses was drilled from 450 to 680 feet. Sample volume of gravel was 5-15%. The andesite sand drilled from 630-680 feet became finer as drilling progressed to borehole bottom.

Short and long normal electric, guarded resistivity, spontaneous potential, six foot lateral and natural gamma logs were done at DSMW5. Figure 2 is a borehole log and well construction diagram for DSMW5. A shallow, uniform sand aquifer was drilled from 0 to 224 feet that has a resistivity ranging from 30-60 ohmeters^2/meter. Logging shows the large clay zone from 225 to 450 feet has a consistent 10-15 ohmeters^2/meter resistivity that separates a shallow and deep aquifer. The deep aquifer from 450 to 680 feet is primarily composed of fine, mafic sand with a 10-20 ohmeters^2/meter resistivity. The deep aquifer formation had higher water production during drilling than the higher resistivity, shallow aquifer formation found above 230 feet(see Borehole Samples, Table 2). Overall, aquifer formations in DSMW5 have a slightly higher resistivity and higher at point formation discharge than the formations drilled at DSMW6.

FIGURE 2
GEOPHYSICAL LOGS & WELL CONSTRUCTION
MONITORING WELL DSMW5



DSMW6

Alluvium containing coarse granitic and felsic volcanic sand with intermittent clay layers from 5 to 20 feet thick, was drilled from 0 to 150 feet. Pliable, sticky to hard, brown and blue /gray clay was drilled from 150 to 250 feet. Medium to coarse grained sub-round volcanic and granitic sand, with intermittent clay zones was drilled from 250 to 480 feet. Small to coarse gravel with a sample volume between 10-30% was drilled in this section between 250 and 300 feet. Moderately sorted, mafic volcanic sand with stringers of sandy clay and small gravel was drilled from 480 to 620 feet. Sample volume of gravel ranged between 10-25%.

Short and long normal electric, single point and spontaneous potential logs were done at DSMW6. A guarded resistivity log was not conducted at this site due to logging equipment failure. Figure 3 is a borehole log and well construction diagram for DSMW6. The resistivity logs showed large clay zones with 5-10 ohmeters^2/meter resistivity from 150 to 230 feet and 300 to 332 feet. Thinner, intermittent clay beds with a similar low resistivity were found throughout the borehole. The primary water bearing formations from 330 to 520 feet have a resistivity of 10-15 ohmeters^2/meter. The finer volcanic sand and sandy clay formation from 520 to 620 feet have a resistivity of 5-10 ohmeters^2/meter. The water bearing formations identified in DSMW6 by the borehole geophysics, have an overall low formation resistivity however the high discharge samples collected during drilling suggest a reasonably high formation permeability(Borehole Samples, Table 2).

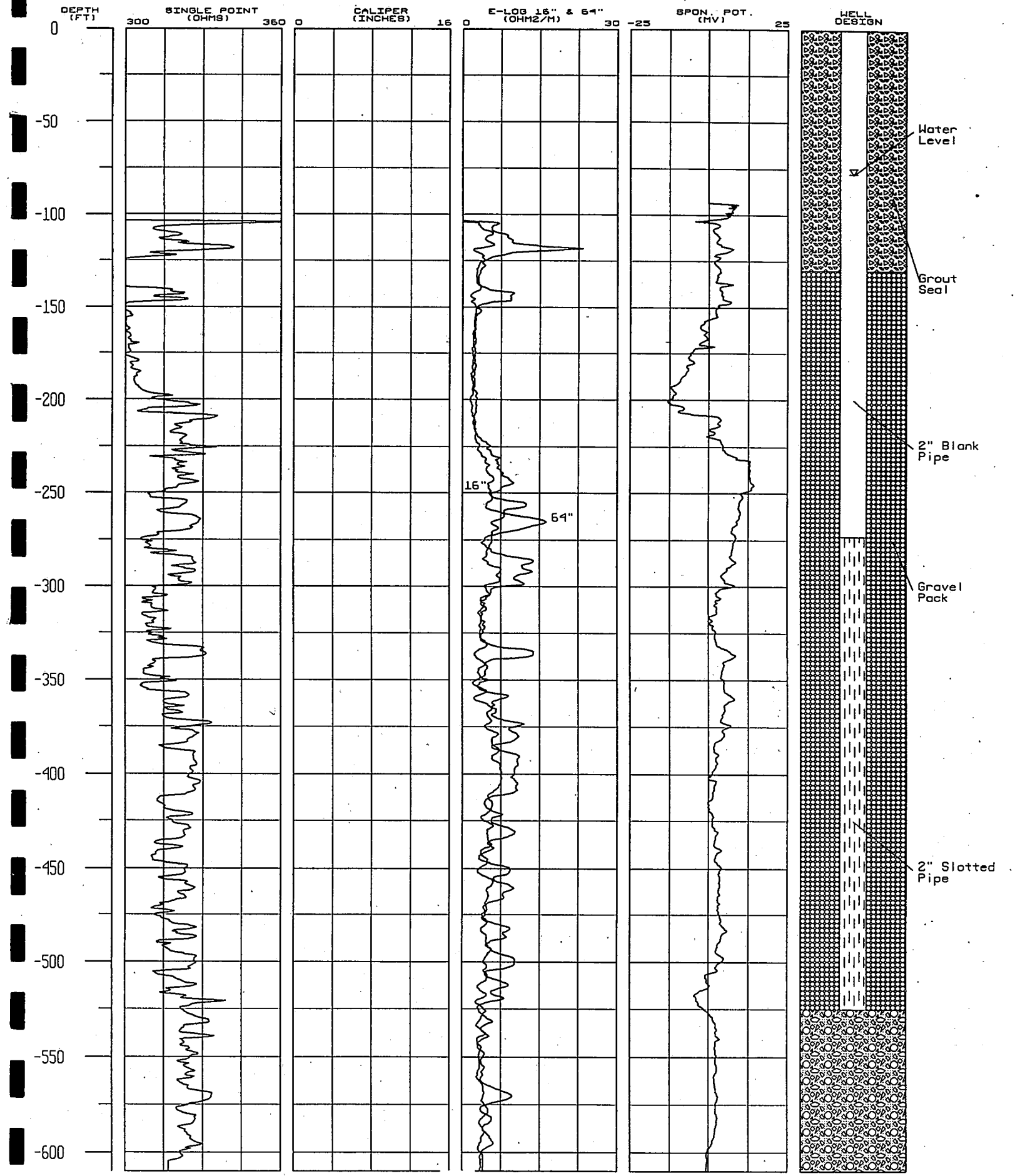
Five borehole samples were collected from each well for sieve analysis so a screen slot size and appropriate gravel filter pack could be selected for production well construction. Sieve analysis were performed by Roscoe Moss Company, Sacramento, CA. A screen size of 50 slot (0.05") was recommended for DSMW5 with a gravel filter pack of #6 x #8 and a screen size of 80 slot (0.08") was recommended for DSMW6 with a 1/8" x 1/4" gravel filter pack. Screen size was selected to allow 90% filter pack retention. Complete sieve analyses are found in the appendix.

Borehole Samples

The primary goal of drilling the monitoring wells by the dual tube reverse method was the ability to collect a water sample from a discrete portion of the aquifer with minimal delays in operation and few equipment changes. Water samples were collected from various borehole depths in order to verify if arsenic or Nitrate-N concentrations were located in isolated formations or continuous throughout the borehole. Water quality samples were collected at points specified by the supervising geologist with selection criteria for sampling based on adequate formation discharge, discharge clarity and lithology. At point formation discharge rate, formation water temperature and a field measurement for NO^3-N were also collected at each sampling.

Nitrate and arsenic samples were analyzed by Sierra Environmental Monitoring (SEM) of Reno, Nevada. Field measurements for nitrate were made using a LaMotte Field Testing Kit for NO^3-N with a range of 0-18 ppm. Discharge measurements were estimated by bucket test at the discharge end of the cyclone splitter. Temperature was measured using a standard glass thermometer. Table 2 shows a summary of field parameters measured and SEM laboratory results for the borehole water samples collected from each site.

FIGURE 3
GEOPHYSICAL LOGS & WELL CONSTRUCTION
MONITORING WELL DSMW6



Well	Sample Depth Feet	NO^3-N Field ppm	NO^3-N(SEM) mg/L	Arsenic mg/L	Temperature °F	At Point Discharge gpm
DSMW5	180	2-3	2.1	0.085	65	60
	410	6-7	4.2	0.098	60	100
	580	2-4	2.4	0.11	75	200
	680	1-2	<1	0.18	92	180-200
DSMW6	200	0-1	0.3	0.088	n/a	25-30
	260	0-1	<0.1	0.12	80	50-60
	340	0-1	<0.1	0.068	90	85
	400	0-1	<0.1	0.061	90	100
	460	0-1	<0.1	0.065	93	150
	560	0-1	<0.1	0.076	95	150
	610	0-1	<0.1	0.078	n/a	150+

Table 2
Formation Water Samples

Borehole sampling, at DSMW5 and DSMW6 did not identify a specific formation or borehole section that is the primary source for nitrate and arsenic. Arsenic concentrations in DSMW6 remained relatively consistent and appear to be associated with the elevated thermal water gradient throughout the borehole. This suggests that the well is located near a lineament that conveys hydrothermal formation water along a structure that could range from an isolated basin feature to inter-basin in size. A convenient structure for water movement is the regional Warms Springs fault zone that trends north along Hungry Ridge at the western edge of Spanish Springs Valley (Bell, 1969), approximately 1/2-1 mile away from DSMW6. Nitrate concentration did not exceed 0.3 mg/L throughout the borehole, indicating the well penetrates an aquifer which is not in contact with nitrate bearing lacustrine sediments seen in existing monitoring wells to the north. Nitrate contamination in DSMW6 from domestic septic systems in the HAWCO and Sky Ranch subdivisions should be minimized by the well's upgradient location.

DSMW5 had nitrate levels that did not exceed drinking water maximum contaminant levels and decreased with drilling depth. The clay unit provides a natural vertical barrier that restricts downward migration of nitrate between the shallow and deep aquifer. Nitrate levels in the clay aquitard penetrated by DSMW5 were measured at 4 mg/L(Table 2, sample DSMW5-410). The nitrate value measured in the clay unit can be considered a baseline or natural value so a nitrate increase above this level in the shallow aquifer could be attributed to man made sources such as septic tank and leach field discharge. The final sample taken at DSMW5 (680 feet) showed the nitrate level had dropped to a similar concentration level measured in DSMW6, indicating that a common formation between the two wells exists. Arsenic levels increased as borehole depth increased, but stayed within a range of 0.10 mg/L. The uniformity of the arsenic concentration and sample water temperature throughout the borehole show DSMW5 is affected by the same geologic structure and thermal setting responsible for high arsenic levels in DSMW6.

Water Quality

Water quality samples for inorganic compounds, which included testing for trace metals and routine mineral analysis, were collected at both monitoring wells. Samples were collected from both wells

upon completion of air development. Water samples for inorganic compounds were collected in one gallon plastic milk bottles and 60 milliliter(ml) plastic bottles preserved with nitric and sulfuric acid. Water samples were analyzed by the Nevada State Health Lab in Reno, Nevada.

DSMW5 and DSMW6 meet State of Nevada primary and secondary drinking water standards for all parameters tested except arsenic and nitrate-N. The current(5/97) State of Nevada maximum contaminant level for arsenic is 0.05 mg/L and 10 mg/L for nitrate-N. Complete water quality analyses for each well are found in the appendix. A general water quality summary for each well is found in Table 2. Constituents that do not meet primary drinking water standards are shaded. Overall water quality is better at DSMW6 than DSMW5 which is presumably caused by the partial penetration of lacustrine sediments by DSMW5.

Well	TDS	Nit.-N	SO^4	Cl	HCO^3	Fe	Na	K	Ca	Fl	As
DSMW5	337	0.1	69	14	144	17	108	1	4	2.12	**0.117**
DSMW6	199	0.0	18	7	95	0.13	72	0	1	0.93	**0.06**

Table 3 Values in mg/L
Water Quality Summary

Figure 4 is a Piper diagram used to categorize the water analyses collected from the new monitoring wells and selected nearby wells. The diagram shows DSMW5 & 6 are considered to be in a aquifer containing potassium-bicarbonate waters. Bicarbonate geothermal waters can be generally associated with geothermal waters that have migrated some distance from a thermal fracture flow source and mixed with groundwater(Nicholson, 1993). Nicholson also states that higher ratios of sodium(Na) to potassium(K) are indicative of lateral flow, near surface reactions. A shallow, moderately warm, geothermal setting that is located close to a fracture zone could be applied to the area where the new monitoring wells are constructed.

The general trend of monitoring well water classification in Figure 4 indicates water quality is changing as wells transgress across the valley to the northwest. The linear anion trend from Na+K to Ca for the wells plotted probably reflect ground water percolation through different lithologic units, such as andesite sand versus granitic sand. The northeastern Spanish Springs Valley area could provide a target location for production well drilling or investigation of existing agricultural wells (Donovan Well, Figure 5) for potential purchase and use.

Figure 5 is a potentiometric surface map in feet above sea level for the Spanish Springs Valley that was generated using March, 1997 static water level measurements from 27 wells. The map shows a general flow from high elevation in the south and southwest to lower elevation in the north and northeast valley area. A steep gradient develops between DSMW5 and 6 and continues in a stretched "3" shape by DS4 and continues south to DS1. The steep contour levels suggest a structural uplift caused by faulting. The skewed "3" shape also suggests that a small depression or graben, with uplifted flanks to the north and south may enclose DS4. This is a limited interpretation based on interpolation without any static water level data or drilling information upgradient or west-southwest from DS4. Figure 5 may identify a geologic structure that isolates DS4 from poorer quality formation water observed in monitoring wells to the north and northeast. A faulted basin

Figure 4
Piper Diagram
Selected Monitoring Wells

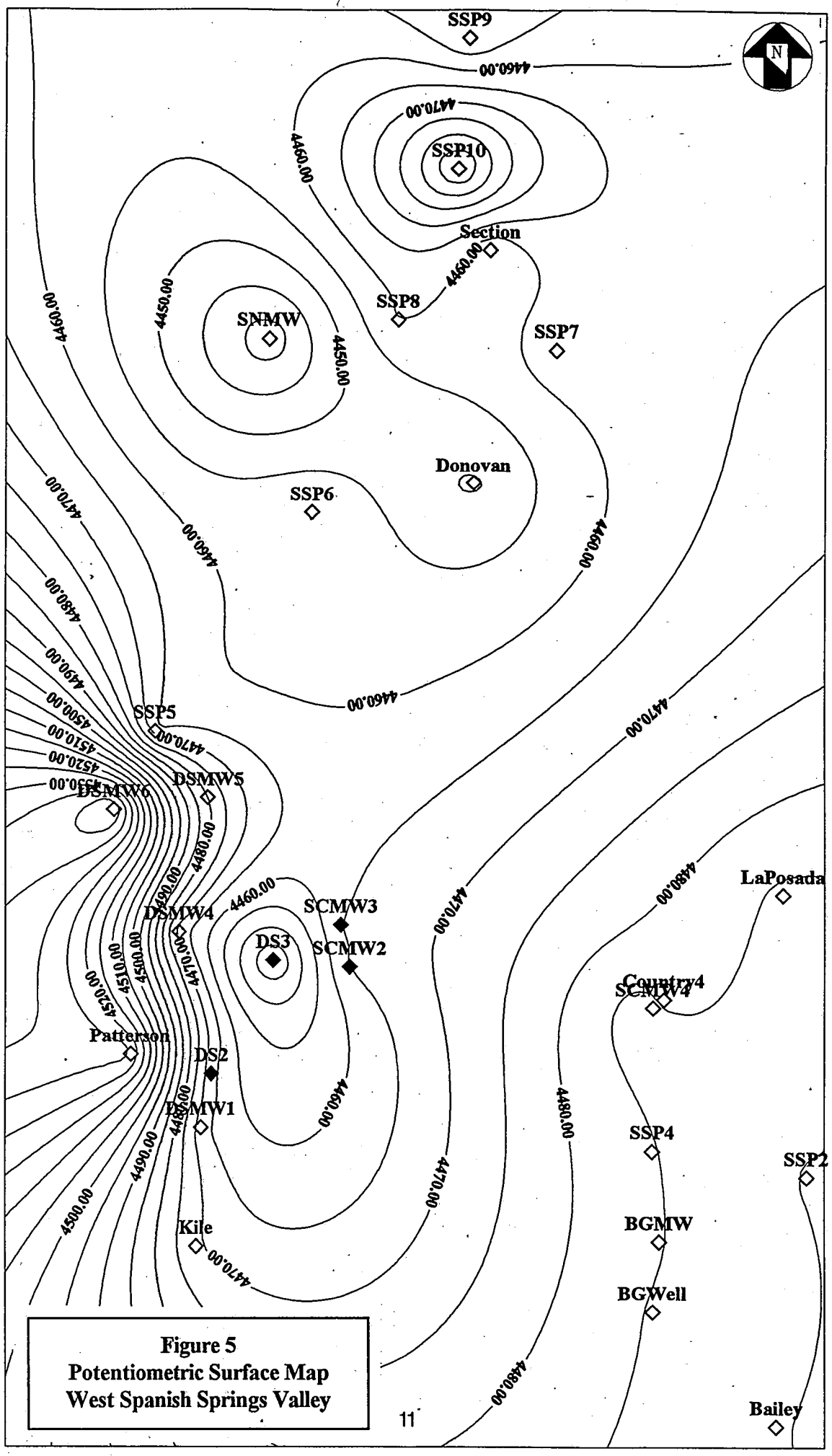


Figure 5
Potentiometric Surface Map
West Spanish Springs Valley

could alter groundwater flow paths and provide a ground water barrier which isolates DS4 from geothermal influence. Conversely, faulting could act as a groundwater barrier in one direction while providing a mechanism for geothermal fluid transport from a larger geologic structure into another area.

Conclusions

Production wells can be constructed at either DSMW5 or DSMW6 if the arsenic concentration in the wells can be reduced by on site treatment. Elevated formation water temperature may further restrict the value of production well construction if mixing higher temperature groundwater in the existing Desert Springs Water System is considered undesirable by the WCUSD. Production well construction may be viable in the future as service areas expand since the wells have high potential well yield and low nitrate concentrations when compared to existing wells in the area. Recommendations for production well construction are found in Table 4.

Well	Cased Depth Feet	Diameter Inch	Blank Interval Feet	Screened Interval Feet	Seal Depth Feet	Screen Size Slot #
DSMW5	660	12	460	200	130	50
DSMW6	620	12	360	260	100	80

Table 4
Production Well Recommendations

At the time of monitoring well completion, the potential for a long term agreement between Westpac Utilities and the County for wholesale water purchase and delivery to Spanish Springs Valley is viable and being actively pursued by both entities. Staff does not advocate production well construction because of the high arsenic content in the aquifer formations. Production well construction can always be reconsidered in the future when a wholesale agreement reaches completion or if water treatment technology has progressed to where arsenic removal is economical and applicable to municipal water wells. If production well construction becomes an option, the DSMW6 site is the preferred choice based upon water quality and upgradient location from existing development.

Bell, J.W., and Bonham, H.F., 1987, Vista Quadrangle (7.5 minute)
Geologic Map, Nevada Bureau of Mines and Geology.

Bonham, H.F., 1969, Geology and mineral deposits of Washoe and Story Counties, Nevada, Nevada Bureau of Mines and Geology, Bulletin 70, p 51.

Fetter, C. W., 1988, Applied Hydrogeology, Merrill Publishing Co.
pp 355-356.

Garside, Larry J. and Schilling, John H., Thermal Waters of Nevada, Nevada Bureau of Mines and Geology, Bulletin 91, pp 66, 134 and 138.

Klein, Cornelis, Hurlbut, Cornelius, Manual of Mineralogy, 20th Edition, John Wiley & Sons
pp 480-485.

Nicholson, 1993, Geothermal Fluids, pp 19-23, 46.

APPENDIX

DESERT SPRINGS MONITORING WELLS 5 & 6
BID RESULTS SEPTEMBER 11, 1996

ITEM		Quantity	Units	Engineers Estimate Price	Engineers Estimate Total	Welsco Corporation Price	Welsco Corporation Total	Layne Christensen Co. Price	Layne Christensen Co. Total
1	Mobilization-Demobilization	2	Each	3000.00	6000.00	1250.00	2500.00	3200.00	6400.00
2	Drill 6 inch Borehole	1200	L. F.	18.00	21600.00	20.00	24000.00	20.00	24000.00
3	Water Quality Samples	16	Each	250.00	4000.00	425.00	6800.00	100.00	1600.00
4	Geophysical Logs	2	Each	2100.00	4200.00	3100.00	6200.00	2300.00	4600.00
5	2 Inch Blank Steel Pipe	800	L. F.	7.00	5600.00	4.75	3800.00	11.00	8800.00
6	2 Inch Slotted Steel Pipe	500	L.F.	10.00	5000.00	5.95	2975.00	17.00	8500.00
7	Gravel Pack	8	Cu. Yds	200.00	1600.00	195.00	1560.00	581.00	4648.00
8	Grout Sanitary Seal	200	Feet	15.00	3000.00	10.00	2000.00	4.00	800.00
9	Air Development	32	Hour	250.00	8000.00	225.00	7200.00	200.00	6400.00
10	Standby	10	Hour	200.00	2000.00	135.00	1350.00	170.00	1700.00
11	Protective Well Cap	2	Each	750.00	1500.00	250.00	500.00	300.00	600.00
			Total		**62500.00**		**58885.00**		**68048.00**

ITEM		Quantity	Units	Lang Exploratory Drilling Price	Lang Exploratory Drilling Total	Beylik Drilling Price	Beylik Drilling Total
1	Mobilization-Demobilization	2	Each	4000.00	8000.00	2800	5600.00
2	Drill 6 inch Borehole	1200	L. F.	26.00	31200.00	60	72000.00
3	Water Quality Samples	16	Each	135.00	2160.00	200	3200.00
4	Geophysical Logs	2	Each	4050.00	8100.00	3327	6654.00
5	2 Inch Blank Steel Pipe	800	L. F.	14.00	11200.00	5.5	4400.00
6	2 Inch Slotted Steel Pipe	500	L.F.	18.00	9000.00	10	5000.00
7	Gravel Pack	8	Cu. Yds	600.00	4800.00	640	5120.00
8	Grout Sanitary Seal	200	Feet	6.00	1200.00	11	2200.00
9	Air Development	32	Hour	265.00	8480.00	200	6400.00
10	Standby	10	Hour	220.00	2200.00	395	3950.00
11	Protective Well Cap	2	Each	500.00	1000.00	350	700.00
			Total		**87340.00**		**115224.00**

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

PRINT OR TYPE ONLY
DO NOT WRITE ON BACK

DSMW-5

STATE OF NEVADA

DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

OFFICE USE ONLY
Log No.
Permit No.
Basin

NOTICE OF INTENT NO. 26241

1. OWNER WASHOE COUNTY
MAILING ADDRESS P.O. BOX 11130
RENO, NEVADA 89520

ADDRESS AT WELL LOCATION
SPANISH SPRINGS VALLEY

2. LOCATION NE ¼ NW ¼ Sec. 34 T 21 N/S R 20 E WASHOE County
PERMIT NO. M/O-1067 (Issued by Water Resources) N/A (Parcel No.) N/A (Subdivision Name)

3. WORK PERFORMED
☒ New Well ☐ Replace ☐ Recondition
☐ Deepen ☐ Abandon ☐ Other

4. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☒ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☐ Rotary ☒ RVC
☐ Air ☐ Other

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
SAND - GRAVEL		0	40	40
SAND - GRAVEL		40	220	180
SAND - KIFE		220	225	5
GRAVEL - START CLAYS				
CLAYS - GRAY		225	405	180
SAND		405	412	7
CLAYS - SAND STRINGERS		412	560	148
SAND GRAVELS		560	640	80
CLAYS - KIFE SAND		640	680	40

Date started FEBRUARY 7, 1997, 19
Date completed FEBRUARY 10, 1997, 19

7. WELL TEST DATA
TEST METHOD: ☐ Bailer ☐ Pump ☒ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)
45		

8. WELL CONSTRUCTION
Depth Drilled 680 Feet Depth Cased 670 Feet

HOLE DIAMETER (BIT SIZE)

	From	To
12-1/4 Inches	0 Feet	20 Feet
6-1/4 Inches	20 Feet	680 Feet
Inches	Feet	Feet

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
8-3/4	28.55	.312	0	20
2.376	5.02	.210	+2	460

Perforations:
Type perforation SLOT
Size perforation 3/32
From 460 feet to 670 feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

Surface Seal: ☒ Yes ☐ No
Depth of Seal 100
Placement Method: ☒ Pumped ☐ Poured
Seal Type: ☒ Neat Cement ☐ Cement Grout ☐ Concrete Grout

Gravel Packed: ☒ Yes ☐ No
From 680 feet to 105 feet

9. WATER LEVEL
Static water level 42 feet below land surface
Artesian flow N/A G.P.M. N/A P.S.I.
Water temperature 85 °F Quality GOOD

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name LANG EXPLORATORY DRILLING (Contractor)
Address 2286 WEST 1500 SOUTH (Contractor)
SALT LAKE CITY, UTAH 84104
Nevada contractor's license number issued by the State Contractor's Board 0021976
Nevada driller's license number issued by the Division of Water Resources, the on-site driller 1410
Signed JOHN VIERGUTZ John Viergutz (By driller performing actual drilling on site or contractor)
Date FEBRUARY 10, 1997

(Rev. 3-91)

USE ADDITIONAL SHEETS IF NECESSARY

(O)-627

DSMW-6

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

PRINT OR TYPE ONLY
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DIVISION OF WATER RESOURCES

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☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☒ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☐ Rotary ☒ RVC
☐ Air ☐ Other

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
SAND GRAVEL		0	40	40
SAND - CLAYS		40	60	20
SAND - GRAVEL		60	70	10
BROWN CLAY	STATIC	70	90	20
SANDY CLAYS		90	100	10
CLAYS - SOME SAND		100	130	30
GREY CLAY - SOME SAND		130	226	96
CLAY -SAND		226	250	24
GRAY CLAY - SAND		250	290	40
SAND GRAVEL		290	300	10
GRAY CLAY		300	330	30
SAND - GRAVEL		330	340	10
GRAY CLAY		340	350	10
SAND GRAVEL		350	400	50
SAND GRAVEL - SOME CLAYS		400	450	50
SAND GRAVEL		450	520	20
SAND - CLAYS		520	620	100

Date started FEBRUARY 10, 19 97
Date completed FEBRUARY 12, 19 97

7. WELL TEST DATA
TEST METHOD: ☐ Bailer ☐ Pump ☒ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)
30		

8. WELL CONSTRUCTION
Depth Drilled 620 Feet Depth Cased 523 Feet

HOLE DIAMETER (BIT SIZE)

	From	To
12-1/4 Inches	0 Feet	20 Feet
6-1/4 Inches	20 Feet	620 Feet
Inches	Feet	Feet

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
8-3/4		.312	0	20
2.376		.210	+2	271

Perforations:
Type perforation SLOT
Size perforation 3/32
From 271 feet to 523 feet
From ____ feet to ____ feet
From ____ feet to ____ feet
From ____ feet to ____ feet
From ____ feet to ____ feet

Surface Seal: ☒ Yes ☐ No
Depth of Seal 130
Placement Method: ☒ Pumped ☐ Poured

Seal Type:
☒ Neat Cement
☐ Cement Grout
☐ Concrete Grout

Gravel Packed: ☒ Yes ☐ No
From 620 feet to 130 feet

9. WATER LEVEL
Static water level 76 feet below land surface
Artesian flow N/A G.P.M. N/A P.S.I.
Water temperature 95 °F Quality GOOD

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.

Name LANG EXPLORATORY DRILLING (Contractor)
Address 2286 WEST 1500 SOUTH (Contractor)
SALT LAKE CITY, UTAH 84104

Nevada contractor's license number issued by the State Contractor's Board 0021976
Nevada driller's license number issued by the Division of Water Resources, the on-site driller 1410

Signed JOHN VIERGUTZ John Viergutz (By driller performing actual drilling on site or contractor)
Date 1-15- FEBRUARY 12, 1997

(Rev. 3-91)

USE ADDITIONAL SHEETS IF NECESSARY

(O)-627

IN TRIPLICATE
(PLEASE PRINT OR TYPE)

NEVADA STATE HEALTH LABORATORY

DSMW 5

NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503
(702) 688-1335

131399

RECEIVED MAY 1997 WASHOE COUNTY UTILITY DIVISION

WATER CHEMISTRY ANALYSIS:

Attn: Fees may apply to some types of sample

All of the information below must be filled in or the analysis will not be performed.

State NEVADA County WASHOE
Township 21N Range 20E Section 34
General Location SPANISH SPRINGS VALLEY
Source Address INTERSECTION OF ALENA WAY & CATTIKA

TYPE OF ANALYSIS:

☒ Check here for ROUTINE DOMESTIC ANALYSIS
Circle the constituents needed for PARTIAL ANALYSIS

SAMPLING INSTRUCTIONS:

The sample submitted must be representative of the source. Spring and surface water samples should be as free of dirt and debris as possible. Wells should be pumped thoroughly before sampling, changing the water in the casing at least three times. Product water from filters should be sampled after running for about ten (10) minutes.

Sampled by DAN DIZALAN Date 1/20/97
Owner WASHOE COUNTY Phone 856-7300
Address P.O. BOX 11130
City RENO State NEVADA

REASON FOR ANALYSIS:

- ☐ Loan
- ☐ Personal health reasons
- ☐ Purchase of the property
- ☐ Rental or sale of property
- ☐ Subdivision approval
- ☒ Other POTENTIAL MUNICIPAL WELL SITE

USE OF WATER:

- ☐ Domestic drinking water
- ☐ Geothermal
- ☐ Industrial or mining
- ☐ Irrigation
- ☒ Other MONITORING WELL

Initials DSMW5

REPORT TO:

Name ED EVANS - WCUD
Address P.O. BOX 11130
City RENO
State NV Zip 89520

SOURCE OF WATER:

Filter ☐ Yes ☒ No
Public ☐ Yes ☒ No
Spring X
Well Depth 670 ft.
Hot Cold X
IN USE ☐ Yes ☒ No

Type MONITORING WELL
Name DSMW 5
Surface
Casing diameter 2 in.
Casing depth 670 ft.

The results below are representative only of the sample submitted to this laboratory.

0.1330 341 0.69 24.4 7.3 0.7 313 131399

FOR LABORATORY USE ONLY

Constituent	ppm	Constituent	ppm	Constituent	ppm	Constituent	S.U.
T.D.S. @ ~~103° C~~ 180°C	337	Chloride	14	Iron	1.91	Color	> 70
Hardness	14	Nitrate -N	0.1	Manganese	0.05	Turbidity	65.0
Calcium	4	Alkalinity	146	Copper	0.02	pH	8.65
Magnesium	1	Bicarbonate	144	Zinc	0.00	EC	491
Sodium	108	Carbonate	17	Barium	0.02	SI@20C	-0.14
Potassium	1	Fluoride	2.12	Boron	0.4		
Sulfate	69	Arsenic	0.117	Silica	52		
				GROSS ALPHA	<3 PCi/l	226 RADIUM	—
				GROSS BETA	<3 PCi/l	MEAS	<0.1

PRINT OTHER DESIRED CONSTITUENTS BELOW

Constituent	ppm
Cd	<0.001
Cr	<0.005
Pb	<0.005
Hg	<0.0005
Se	<0.001
Ag	<0.005

APR 28 1997

Fee
Collected by
PWS I.D.
SDWA—Pri Sec
1st 2nd 3rd
Date Rec'd 1/22/97 Init.

Billed 1/23/97

Remarks P.O. # 158853

Eng 4/28/97

2/11/97

KR

ppm = parts per million, milligrams per liter
S.U. = Standard Units

O-1561 (Rev. 4-92)

IN TRIPLICATE
(PLEASE PRINT OR TYPE)

NEVADA STATE HEALTH LABORATORY
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503
(702) 688-1335

SAMPLE: DSMW6

131347

WATER CHEMISTRY ANALYSIS:

Attn: Fees may apply to some types of samples.

All of the information below must be filled in or the analysis will not be performed.

State NEVADA County WASHOE
Township 21N Range 20E Section 34
General Location SPANISH SPRINGS VALLEY
Source Address 500 FEET WEST OF BEAU DRIVE

TYPE OF ANALYSIS:

☒ Check here for ROUTINE DOMESTIC ANALYSIS.
Circle the constituents needed for PARTIAL ANALYSIS.

SAMPLING INSTRUCTIONS:

The sample submitted must be representative of the source. Spring and surface water samples should be as free of dirt and debris as possible. Wells should be pumped thoroughly before sampling, changing the water in the casing at least three times. Product water from filters should be sampled after running for about ten (10) minutes.

Sampled by ED EVANS - WCUD Date 1/15/97
Owner WASHOE COUNTY Phone 856-7300
Address P.O. BOX 11130
City RENO State NEVADA

REASON FOR ANALYSIS:

☐ Loan
☐ Personal health reasons
☐ Purchase of the property
☐ Rental or sale of property
☐ Subdivision approval
☒ Other POTENTIAL MUNICIPAL WELL LOCATION
SDWA

USE OF WATER:

☐ Domestic drinking water
☐ Geothermal
☐ Industrial or mining
☐ Irrigation
☒ Other MONITORING WELL
Initials

REPORT TO:

Name ED EVANS - WCUD
Address P.O. BOX 11130
City RENO
State NV Zip 89520

SOURCE OF WATER:

Filter ☐ Yes ☒ No
Public ☐ Yes ☒ No
Spring
Well X Depth 620 ft.
Hot Cold X
IN USE ☐ Yes ☒ No

Type MONITORING WELL
Name DSMW6
Surface
Casing diameter 2 in.
Casing depth 525 ft.

As

The results below are representative only of the sample submitted to this laboratory.

FOR LABORATORY USE ONLY

0.1993 193 0.65 16.1 5.9 1.0 209 131347

Constituent	ppm	Constituent	ppm	Constituent	ppm	Constituent	S.U.
T.D.S. @ 103° C.	199	Chloride	7	Iron	0.13	Color	15
Hardness	3	Nitrate -N	0.0	Manganese	0.00	Turbidity	3.5
Calcium	1	Alkalinity	118	Copper	0.00	pH	8.90
Magnesium	0	Bicarbonate	95	Zinc	0.00	EC	307
Sodium	72	Carbonate	24	Barium	0.01	SI@20C	-0.56
Potassium	0	Fluoride	0.93	Boron	0.1		
Sulfate	18	Arsenic	0.060	Silica	34		
				GROSS ALPHA	<3 Pc/l	RADIUM 226	—
				GROSS BETA	<3 Pc/l	MBAS	<0.1

PRINT OTHER DESIRED CONSTITUENTS BELOW

Constituent	ppm
Cd	<0.001
Cr	<0.005
Se	<0.001
Pb	<0.005
Hg	<0.0005
Ag	<0.005

RECEIVED
APR 03 1997
BUREAU OF HEALTH PROTECTION SERVICES
Carson City

Fee
Collected by
PWS I.D.
SDWA—Pri Sec
1st 2nd 3rd
Date Rec'd Init.
ppm = parts per million, milligrams per liter
S.U. = Standard Units

Received 2/2/97

Remarks USE PO# 158853 Eg 3/28/97 KR 2/4/97

CHEMICAL QUALITY MEETS THE STATE OF NEVADA DRINKING WATER STANDARDS.

pH STANDARD RANGE - 6.5-8.5 S.U.
ARSENIC STANDARD 0.05

KG 4-3-97

O-1561 (Rev. 4-92)

Laboratory Analysis Report

Sierra Environmental Monitoring, Inc.

WASHOE COUNTY UTILITY DIV.
ED EVANS
P.O. BOX 11130
RENO NV 89520

Date : 1/23/97
Client : WAS-314
Taken by: CLIENT-E. EVANS
Report : 18649
PO# : 160395

Sample	Collected Date	Time	NITRATE-N MG/L	ARSENIC ICP-MS MG/L				
MW5 - 180	1/16/97	11:45	2.1N	0.085				
MW5 - 410	1/17/97	9:00	4.2N	0.098				
MW5 - 580	1/17/97	14:45	2.4N	0.11				
MW5 - 680	1/17/97	18:30	<1N *	0.18				

Approved By:

William F. Pillsbury
President

1135 Financial Blvd.
Reno, NV 89502
Phone (702) 857-2400
FAX (702) 857-2404

John C. Seher
Manager

Laboratory Analysis Report

Sierra Environmental Monitoring, Inc.

WASHOE COUNTY UTILITY DIV.
ED EVANS
P.O. BOX 11130
RENO NV 89520

Date : 1/17/97
Client : WAS-314
Taken by: CLIENT-E. EVANS
Report : 18593
PO# : 160395

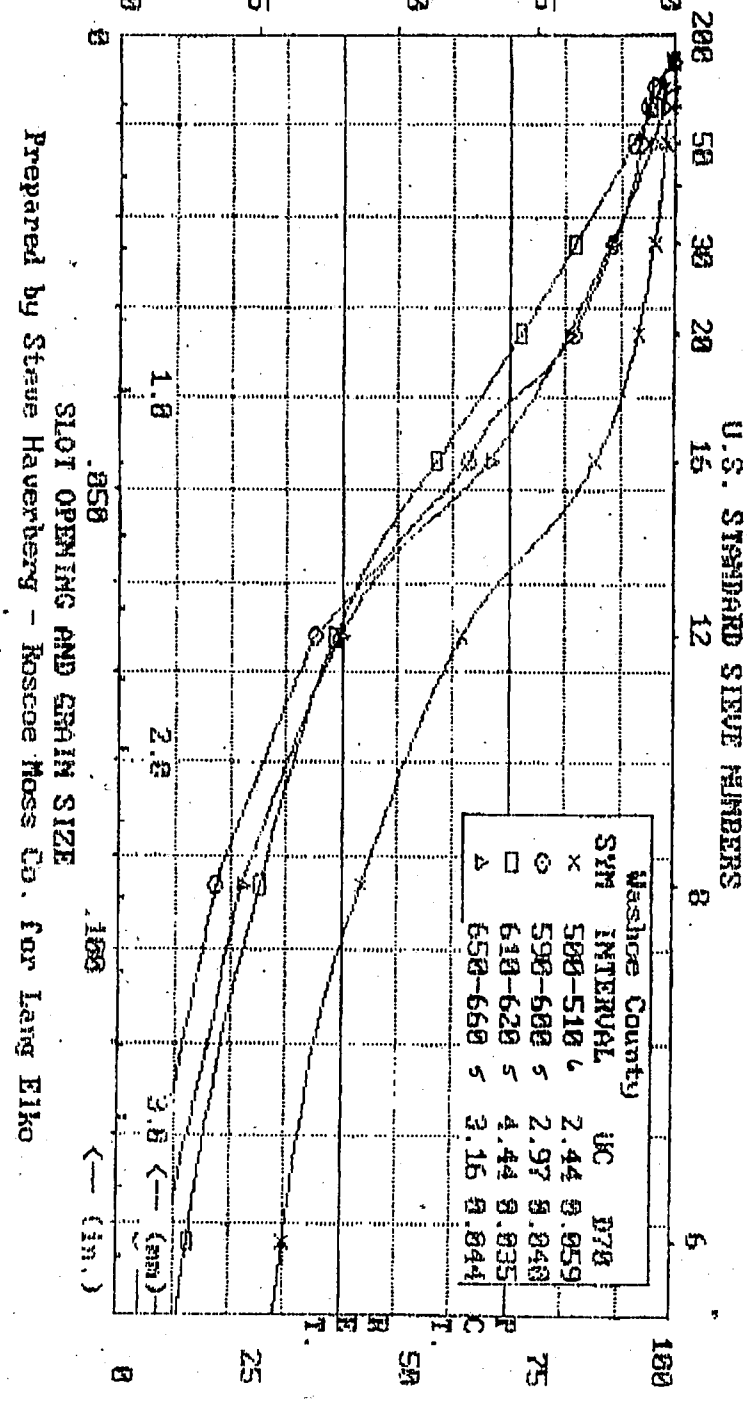
Sample	Collected Date	Time	NITRATE-N MG/L	ARSENIC ICP-MS MG/L				
MW6-200	1/10/97	15:30	0.3N	0.088				
MW6-260	1/10/97	17:45	<0.1N	0.12				
MW6-340	1/10/97	9:30	<0.1N	0.068				
MW6-400	1/11/97	11:30	<0.1N	0.061				
MW6-460	1/11/97	13:30	<0.1N	0.065				
MW6-560	1/11/97	16:15	<0.1N	0.076				
MW6-610	1/11/97	18:00	<0.1N	0.078				

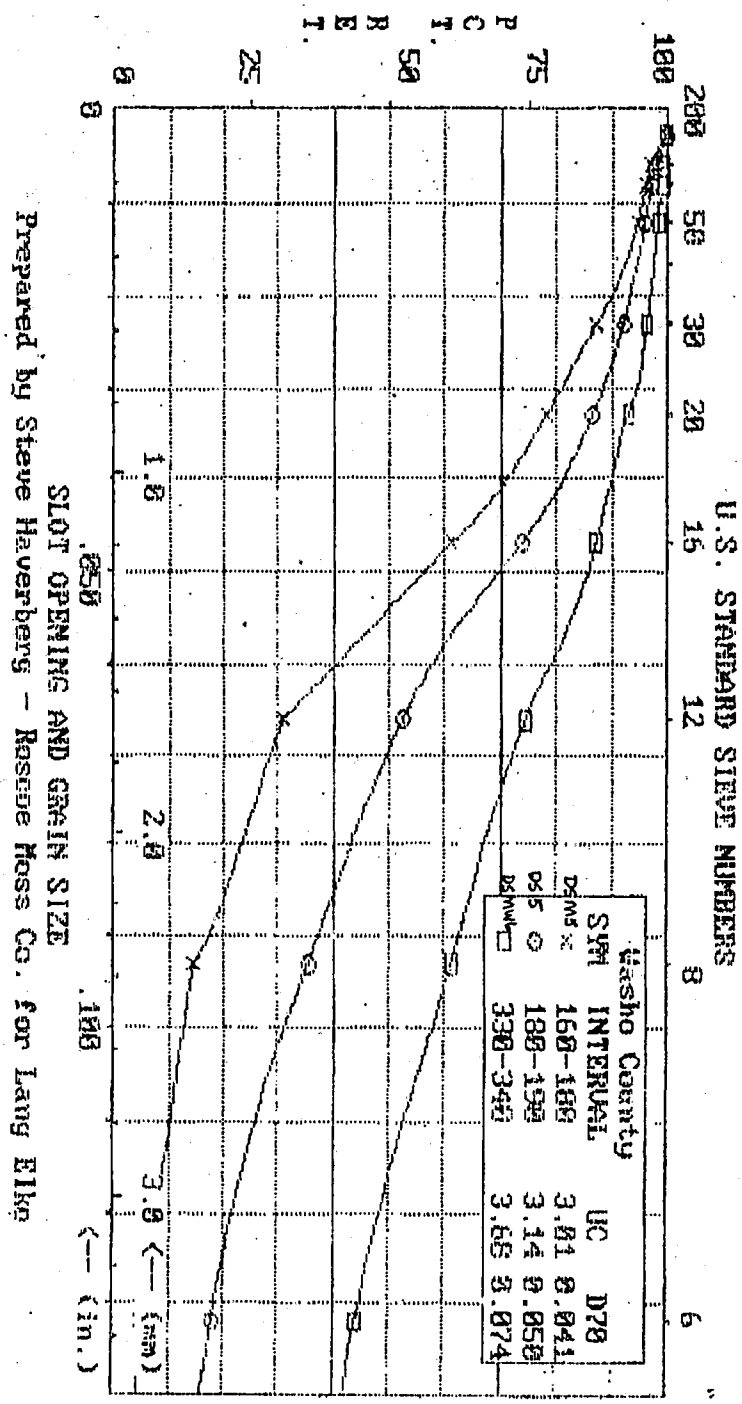
Approved By: _____

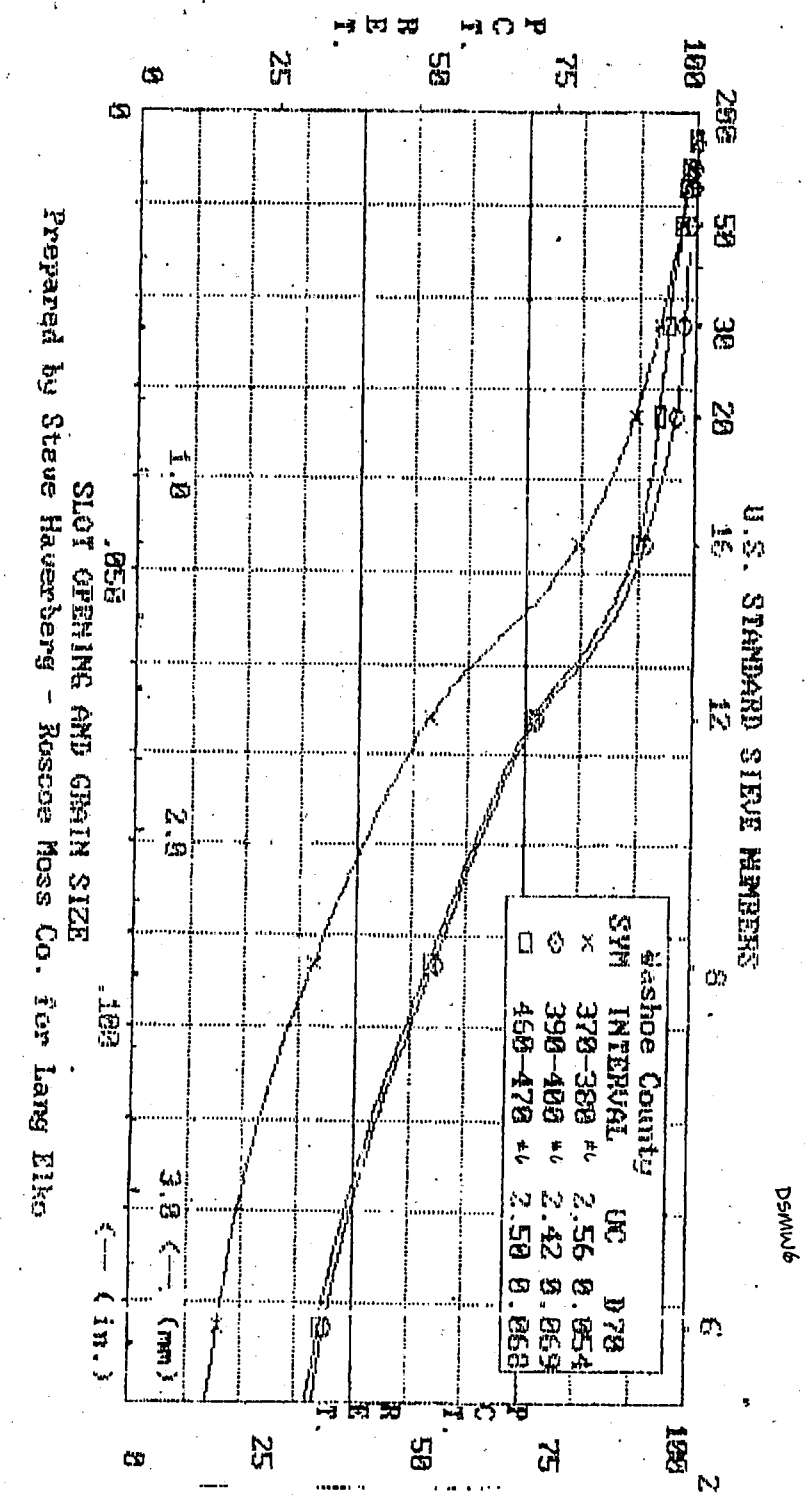
1135 Financial Blvd.
Reno, NV 89502
Phone (702) 857-2400
FAX (702) 857-2404

William F. Pillsbury
President

John C. Seher
Manager


U.S. STANDARD SIEVE NUMBERS
200 50 30 20 15 12 8 5
100
75
50
25
0
PCT. RET.
Washoe County
SYM INTERVAL UC D70
× 500-510 2.44 0.959
○ 590-600 2.97 0.048
□ 610-620 4.44 0.035
△ 650-660 3.16 0.044
SLOT OPENINGS AND SAMPLE SIZE
1.0 2.0 3.0 (mm)
.050 .100 (in.)
Prepared by Steve Haverberg - Roscoe Moss Co. for Lang Elko


U.S. STANDARD SIEVE NUMBERS
200 50 30 20 16 12 8 6
100
75
50
25
0
PERCENT
Washo County
SYM INTERVAL UC D70
160-180 3.01 0.041
180-198 3.14 0.050
330-342 3.65 0.074
1.0
2.0
3.0
.250
.180
SLOT OPENING AND GRAIN SIZE
Prepared by Steve Haverberg - Roscoe Moss Co. for Lang Elko
CLIENT: Lang Elko


U.S. STANDARD SIEVE NUMBERS
PERCENT FINER
Washoe County
SYM INTERVAL UC D70
× 370-380 ft 2.56 0.054
◇ 390-400 ft 2.42 0.069
□ 450-470 ft 2.50 0.060
SLOT OPENING AND GRAIN SIZE
Prepared by Steve Haverberg - Roscoe Moss Co. for Lang Elko
(mm)
(in.)

CLIENT: Lang Elko
PROJECT: Washo County

MESH NO.	SIZE (IN)	SAMPLE 160-180 CUWT	160-180 %RET	180-190 CUWT	180-190 %RET	330-340 CUWT	330-340 %RET
3	.263						
1/4	.250						
4	.187	5.0	2	21.0	8	81.0	30
6	.132	13.0	5	50.0	18	121.0	44
8	.093	39.0	15	99.0	36	168.0	61
12	.066	83.0	31	146.0	53	204.0	74
16	.047	163.0	61	205.0	74	239.0	87
20	.033	209.0	78	241.0	87	255.0	93
30	.023	233.0	87	256.0	92	264.0	96
40	.016						
50	.012	253.0	95	267.0	96	270.0	99
70	.008	257.0	96	270.0	97	272.0	99
100	.006	259.0	97	272.0	98	272.2	99
PAN	.003	267.0	100	278.0	100	274.0	100

%RET	SIZE	%RET	SIZE	%RET	SIZE
30	0.068	30	0.102	30	0.185
40	0.060	40	0.086	40	0.147
50	0.054	50	0.069	50	0.116
60	0.048	60	0.058	60	0.096
70	0.041	70	0.050	70	0.074
80	0.031	80	0.041	80	0.059
90	0.020	90	0.027	90	0.040
UC	3.01	UC	3.14	UC	3.68

Analysis by Steve Haverberg - Roscoe Moss Co.

CLIENT: Lang Elko
PROJECT: Washoe County

MESH NO.	SIZE (IN)	SAMPLE 370-380 CUWT	%RET	390-400 CUWT	%RET	460-470 CUWT	%RET
3	.263						
1/4	.250						
4	.187	18.0	7	57.0	21	54.0	19
6	.132	44.0	16	97.0	35	95.0	34
8	.093	90.0	33	149.0	54	148.0	53
12	.066	146.0	53	198.0	72	198.0	71
16	.047	219.0	79	250.0	91	249.0	90
20	.033	247.0	89	265.0	97	260.0	94
30	.023	259.0	94	269.0	98	264.0	95
40	.016						
50	.012	269.0	97	272.0	99	270.0	97
70	.008	272.0	99	273.0	100	272.0	98
100	.006	273.0	99	273.1	100	273.0	99
PAN	.003	276.0	100	274.0	100	277.0	100

%RET	SIZE	%RET	SIZE	%RET	SIZE
30	0.097	30	0.151	30	0.147
40	0.082	40	0.119	40	0.117
50	0.069	50	0.100	50	0.099
60	0.060	60	0.084	60	0.082
70	0.054	70	0.069	70	0.068
80	0.046	80	0.060	80	0.059
90	0.032	90	0.049	90	0.047
UC	2.56	UC	2.42	UC	2.50

Analysis by Steve Haverberg - Roscoe Moss Co.

CLIENT: Lang Elko
PROJECT: Washoe County

MESH NO.	SIZE (IN)	SAMPLE 500-510 CUWT	%RET	590-600 CUWT	%RET	610-620 CUWT	%RET	650-660 CUWT	%RET
3	.263								
1/4	.250								
4	.187	58.0	21	1.0	0	12.0	5	8.0	3
6	.132	82.0	30	11.0	4	30.0	13	21.0	9
8	.093	120.0	44	43.0	17	60.0	25	54.0	22
12	.066	169.0	61	87.0	35	92.0	39	98.0	40
16	.047	235.0	85	156.0	63	135.0	57	164.0	66
20	.033	257.0	93	202.0	81	171.0	72	199.0	81
30	.023	265.0	96	220.0	89	194.0	82	218.0	88
40	.016								
50	.012	271.0	99	233.0	94	219.0	92	237.0	96
70	.008	273.0	99	236.0	95	227.0	96	242.0	98
100	.006	274.0	100	239.0	96	230.0	97	244.0	99
PAN	.003	275.0	100	248.0	100	237.0	100	247.0	100

%RET	SIZE	%RET	SIZE	%RET	SIZE	%RET	SIZE
30	0.131	30	0.074	30	0.083	30	0.080
40	0.099	40	0.063	40	0.064	40	0.066
50	0.082	50	0.056	50	0.053	50	0.057
60	0.068	60	0.049	60	0.044	60	0.051
70	0.059	70	0.040	70	0.035	70	0.044
80	0.052	80	0.034	80	0.025	80	0.034
90	0.041	90	0.021	90	0.014	90	0.021
UC	2.44	UC	2.97	UC	4.44	UC	3.16

Analysis by Steve Haverberg - Roscoe Moss Co.