PNL-6973
UC-11,41

The Installation of the Westbay Multiport Ground-Water Sampling System in Well 699-43-42K Near the 216-B-3 Pond

T. J. Gilmore

September 1989

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

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PACIFIC NORTHWEST LABORATORY
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Prepared for
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Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

In 1988 and 1989, Pacific Northwest Laboratory installed a multiport ground-water sampling system in well 699-43-42K drilled near the 216-B-3 Pond on the Hanford Site in southeastern Washington State. The multiport system will be used to evaluate methods for determining the vertical distribution of contaminants and hydraulic heads in ground water. This installation was in conjunction with a similar multiport installation near the 300 Area of the Hanford Site. Well 699-43-42K is adjacent to two Resource Conservation and Recovery Act (RCRA) ground-water monitoring wells, which will allow for a comparison of sampling intervals and head measurements between the multiport system and the RCRA monitoring wells.

Eight sampling ports were installed in the upper unconfined aquifer by backfilling at depths of 161.1 ft, 174.1 ft, 187.1 ft, 201.17 ft, 217.2 ft, 230.2 ft, 243.2 ft, and 255.2 ft below land surface. However, because of damage to the casing during installation, only the top four ports should be used for pressure measurements and sampling until repairs occur. The locations of the sampling ports were determined by the hydrogeology of the area and the screened intervals of adjacent ground-water monitoring wells.

Installation by backfilling around the multiport system was the first method of its kind on the Hanford Site and proved adequate. For future installations, an alternative method is recommended where the multiport system would be placed inside a cased and screened well using packers to isolate the sampling zones.

CONTENTS

FIGURES

INTRODUCTION

A Westbay multiport ground-water sampling system was installed in a well on the Hanford Site as part of Pacific Northwest Laboratory's (PNL's)[(a)] Site-Wide Ground-Water Monitoring Project. The installation of the multiport system is part of a program to evaluate methods that determine the vertical distribution of contaminants and hydraulic head in the ground water. Two multiport systems were installed during the last quarter of 1988 and the first quarter of 1989. This report discusses the installation and completion of the multiport system in well 699-43-42K near the 216-B-3 Pond on the Hanford Site. A similar report discusses the installation of a multiport system in well 399-1-20 near the 300 Area on the Hanford Site (Gilmore 1989).

The drilling of well 699-43-42K for the multiport system was completed in January 1989 by Onwego Drilling Company, Richland, Washington, under subcontract to PNL. Pacific Northwest Laboratory furnished contract management and supervised the drilling and installation of the multiport system. Geological data were gathered by PNL personnel. Under contract to PNL, Westbay Instruments Ltd. provided initial consultation on the assembly and installation of the system.

Well 699-43-42K is located in southeastern Washington State on the Hanford Site (Figures 1 and 2). Coordinates for well 699-43-42K are N136,445.2 E576,997.5 meters NAD83 (North American Datum of 1983). The well was drilled to a total depth of 263.0 ft and was completed to 261.87 ft. The multiport system was installed immediately adjacent to two Resource Conservation and Recovery Act (RCRA) ground-water monitoring wells, 699-42-42B and 699-43-42J (Figure 2). Well 699-42-42B was completed to 250 ft, and well 699-43-42J was completed to 180 ft (Figure 3). This location will provide a comparison of sampling intervals between the multiport system and the RCRA monitoring wells.

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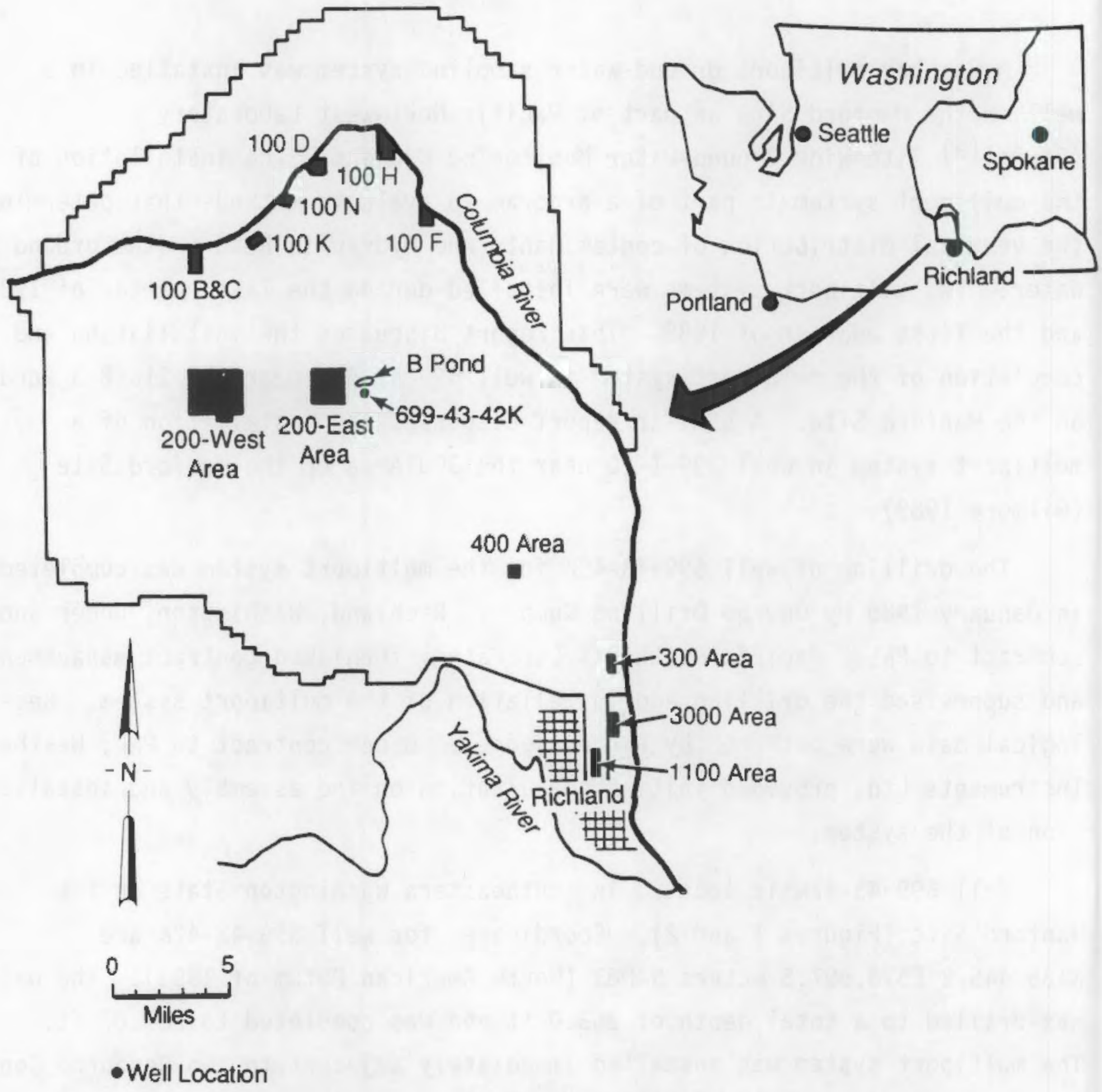

FIGURE 1. Hanford Site Location Map

Appendix A contains the as-built diagrams with a geologic column, geophysical logs, the completion/inspection reports; the casing record sheets for well 699-43-42K; and the gamma log with the lithology and port intervals.

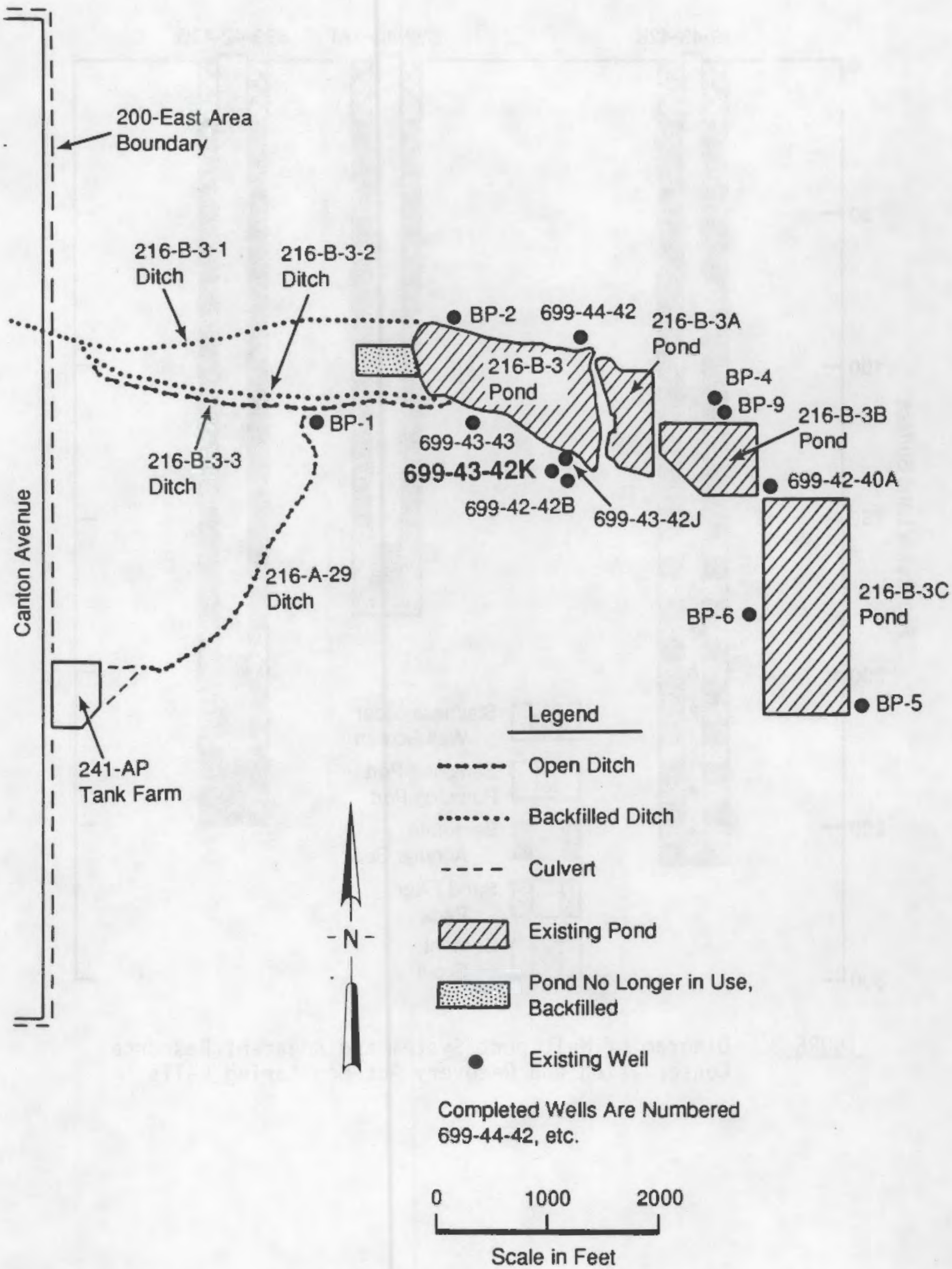

FIGURE 2. Location of 699-43-42K Near the 216-B-3 Pond on the Hanford Site

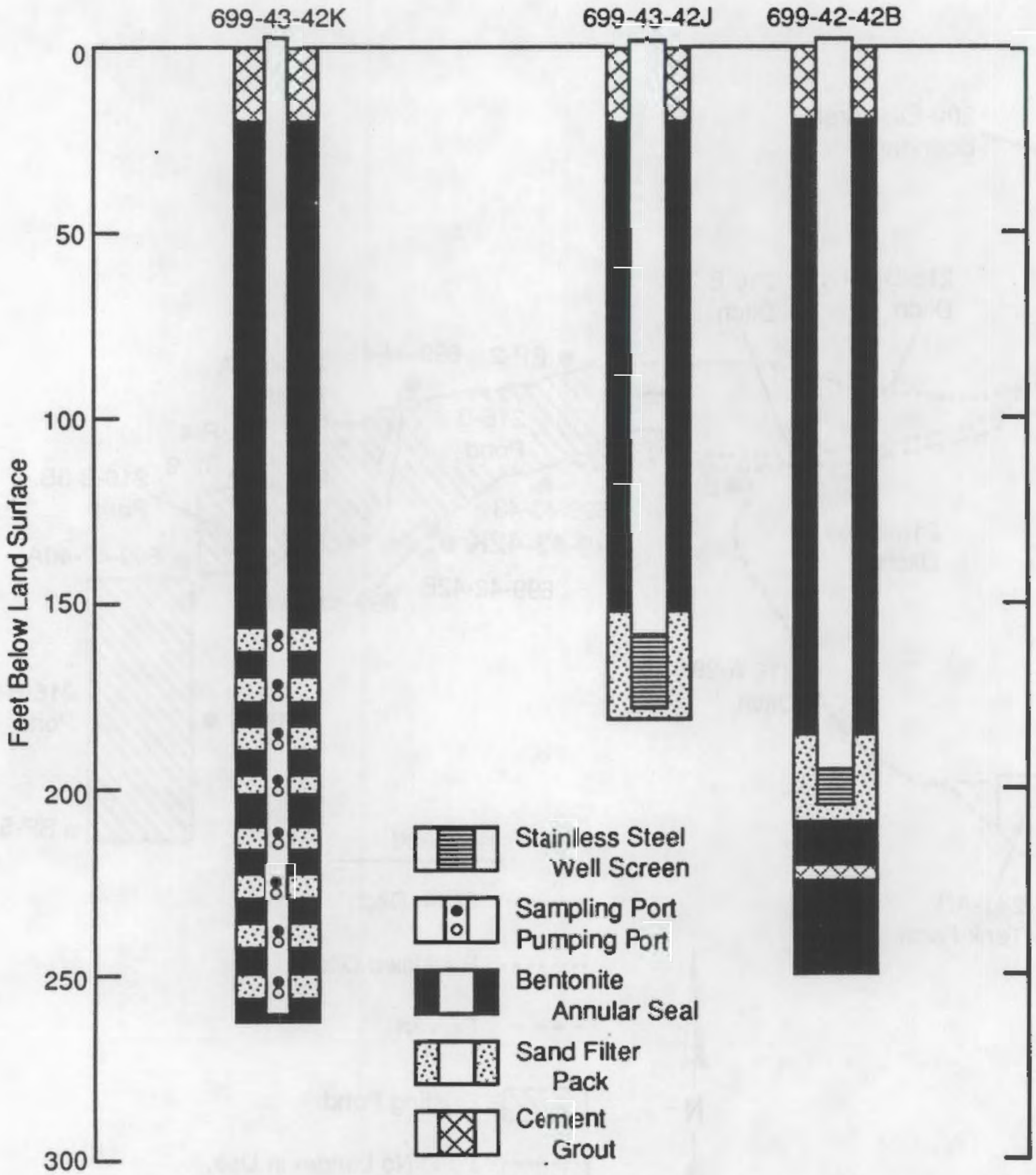

FIGURE 3. Diagram of Multiport System and Adjacent Resource Conservation and Recovery Act Monitoring Wells

GEOLOGY

The stratigraphy in well 699-43-42K closely correlates with that in the adjacent RCRA monitoring wells. Three major stratigraphic formations were encountered during drilling, which include in ascending order the Columbia Basalt Group, the Ringold Formation, and the glacial-fluvial sediments.

The top of the basalt occurs at 243 ft and is present at the final depth of 263 ft below ground surface in well 699-43-42K. The top of the basalt is likely the erosional remnants of the Elephant Mountain Member (Graham, Last, and Fecht 1984). The basalt is very dark grayish brown, amygdaloid, with some oxidized coatings. The amygdules are commonly filled with silicious, white opaline-type material. Between 260 and 258 ft, a zone of relatively easier drilling occurs. The sample descriptions describe this zone as gravely silty-sand composed predominantly of basalt grains. The natural gamma log supports this description and indicates the zone to be coarser grained then the surrounding basalt signature. This zone is possibly an epiblastic interbed or a weathered zone in or between basalt flows.

The Ringold Formation has been identified in the region by Graham, Last, and Fecht (1984) and Tallman et al. (1979), and extends from approximately 243 to 111 ft below the ground surface. The basal, lower, and middle Ringold units are suggested to be present in the region of well 699-43-42K (Graham, Last, and Fecht 1984); however, the correlation of these units to this well requires more characterization work. The Ringold Formation in this discussion is treated as undifferentiated, with the notable lithologic changes discussed. The Ringold Formation is generally characterized by gravels and sands in a silty matrix. There was an increase in the silt and gravel contents over the Hanford formation, but no noticeable increase or decrease in the percentage of basalt grains. Two notable units of clayey silt exist in the well. These occur at 233 to 204 ft and 181 to 150 ft below the ground surface. The layers of clayey silt are bracketed by sandy gravels.

The upper glacial-fluvial sediments informally termed the Hanford formation extend from 111 ft to near the surface. The sediments between 111 ft and 17 ft are composed of unconsolidated well-sorted, medium to fine sands. Thin layers of silt approximately 1 ft thick occur at 97 ft and 93 ft. The sediments are composed of gravelly sand from 17 ft to the surface. Geology logs are presented in Appendix A.

GEOPHYSICAL LOGGING

Pacific Northwest Laboratory logged well 699-43-42K using density, natural gamma, and neutron probes on November 18, 1989. The well was logged between 0 ft and 263 ft. The natural gamma logs were used to verify silt/clay layers and interbeds in the decisions to locate sampling ports (Appendix A).

DRILLING AND INSTALLATION

DRILLING OPERATIONS

Well 699-43-42K was drilled using a Bucyrus Erie 22-W cable tool drilling rig by the drive barrel and hard-tool method. Drilling operations began on September 29, 1988, and continued to November 16, 1988, totaling 36 days of drilling (Figure 4). The total depth of the well was 263 ft. A drive barrel was used to drill between 0 ft and 111 ft, and a hard tool was used between 111 and 236 ft. Temporary telescoping carbon steel 12-in. casing was placed from the surface to 116.5 ft, and 10-in. temporary casing was placed from the surface to the total depth of 258.5 ft. During construction, the 10-in. casing was removed twice, once at 116 ft to replace bent casing and once at 207 ft to replace a lost drive shoe. The drive shoe was not recovered and was pushed into the well sidewall at approximately 206 ft.

INSTALLATION

Prior to the installation of the multiport system, sampling intervals were determined based on the hydrogeology of the borehole and the screened intervals of adjacent monitoring wells. The natural gamma geophysical logs and geology logs were used to locate these sampling intervals. The required multiport casing lengths for the chosen sampling intervals were calculated and the pieces laid out in order. Each casing length was given a number sequentially from the bottom of the monitoring well, and an appropriate coupling was attached to the top of each casing. All casing lengths were measured and recorded (see Appendix A). The multiport components were protected by plastic shipping covers until installation. Casing lengths were 10 ft and under in length in divisions of 5 ft, 2 ft, and 1 ft. The multiport system was constructed of 1.5-in.-inside-diameter polyvinylchloride (PVC) pipe with well screens that measured 2.88 in. outside diameter. The multiport system was then placed in the well inside a 4-in. schedule 80 PVC protective casing. This casing was used to protect the multiport system and keep the screens free of seal material. A centralizer was placed 10 ft from the bottom of the protective casing to center the multiport system in the well. As the multiport system was placed in the well, each assembled joint

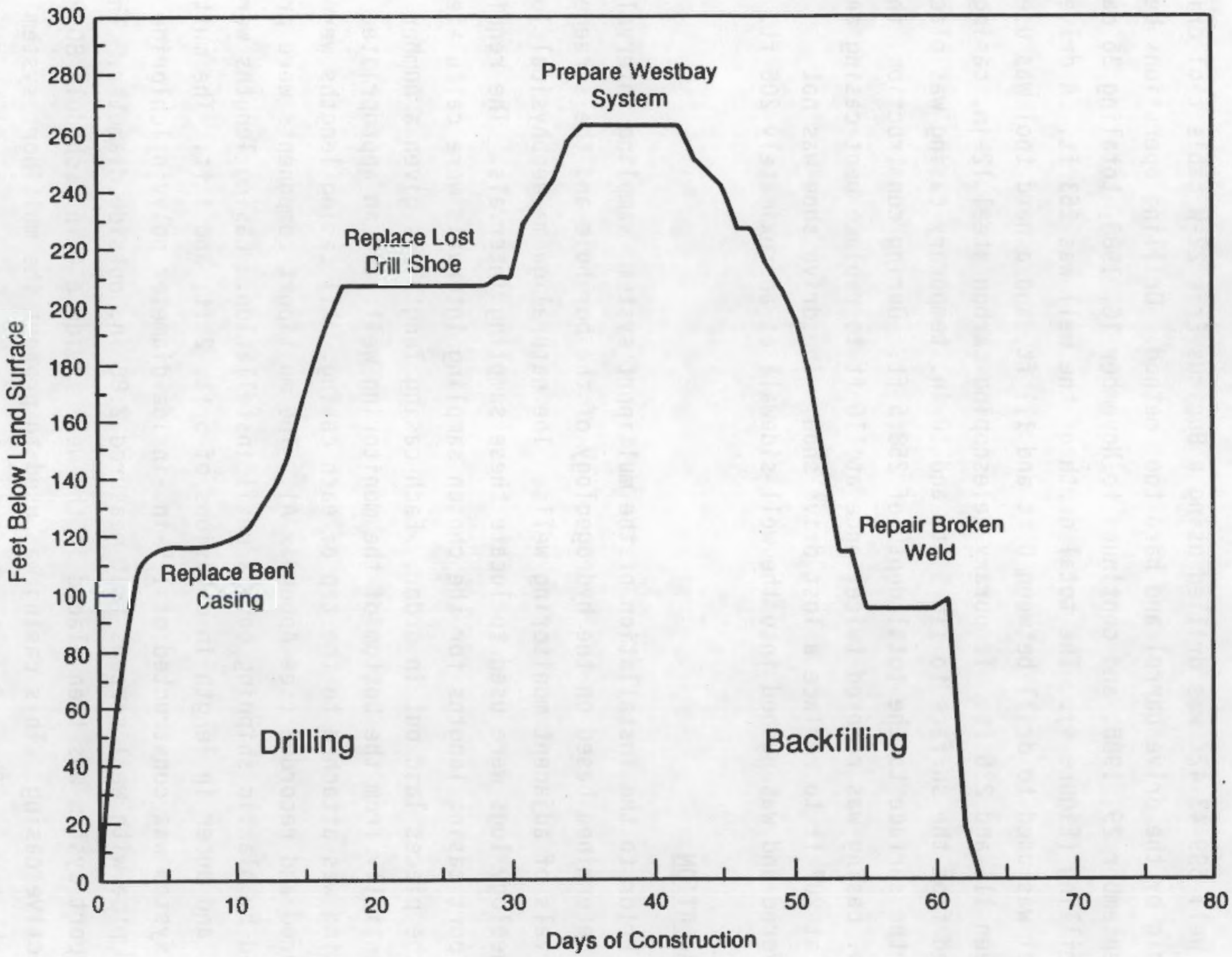

FIGURE 4. Well 699-43-43K Construction Progress Curve

was hydraulically tested by applying a minimum internal pressure of 100 psi. After the multiport system was properly positioned and secured, the system was backfilled.

The temporary carbon steel casing was removed during the backfilling using hydraulic jacks (Figure 5), which proved much easier than using the cable-tool rig to remove the casing (Gilmore 1989). A minimum 1-ft overlap was maintained between the carbon steel casing and the backfill material. A longer overlap was employed when placing the sand filter pack, and a shorter overlap was required when placing the bentonite to reduce "hitching" of the clay on the end of the casing. When the temporary carbon steel casing is cut with an acetylene cutting torch, the protective casing around the multiport system must be shielded from the heat. A 4-in. steel pipe with an adaptive collar to screw into a 4-in. PVC pipe was used over the multiport system to protect the system from the heat.

Backfill Material

A minimum of 10-in. casing was required to accommodate working room for the tremie pipe and protective casing around the multiport system for the placement of the annular filter packs and seals. Eight sampling ports were placed at 161.1 ft, 174.1 ft, 187.1 ft, 201.17 ft, 217.2 ft, 230.2 ft, 243.2 ft, and 255.2 ft below land surface. Backfill around the sampling ports was 20-40 Colorado Silica Sand emplaced by gravity feed. Each sampling port has approximately 2.5 ft of sand filter pack above it and 4.5 ft of filter sand pack below it for a total sampling interval of approximately 7 ft (Figure 6). Medium-size Enviroplug bentonite chunks were placed by gravity feed between the filter sand packs isolating each sampling interval. The medium-size Enviroplug is composed of irregularly shaped bentonite pieces that range in size from 1/4 to 1 in. Prior to placing the bentonite in the well, it was sieved over a coarse mesh screen to remove the fines in order to reduce bridging in the well. The bentonite was then poured through a funnel into a 4-in. PVC tremie pipe for placement in the well. The funnel was used to control the speed of the placement of the bentonite to approximately 2.5 lb/min, because bridging would occur at higher rates. The minimum thickness of the bentonite seals was 5.9 ft between ports 3 and 4.

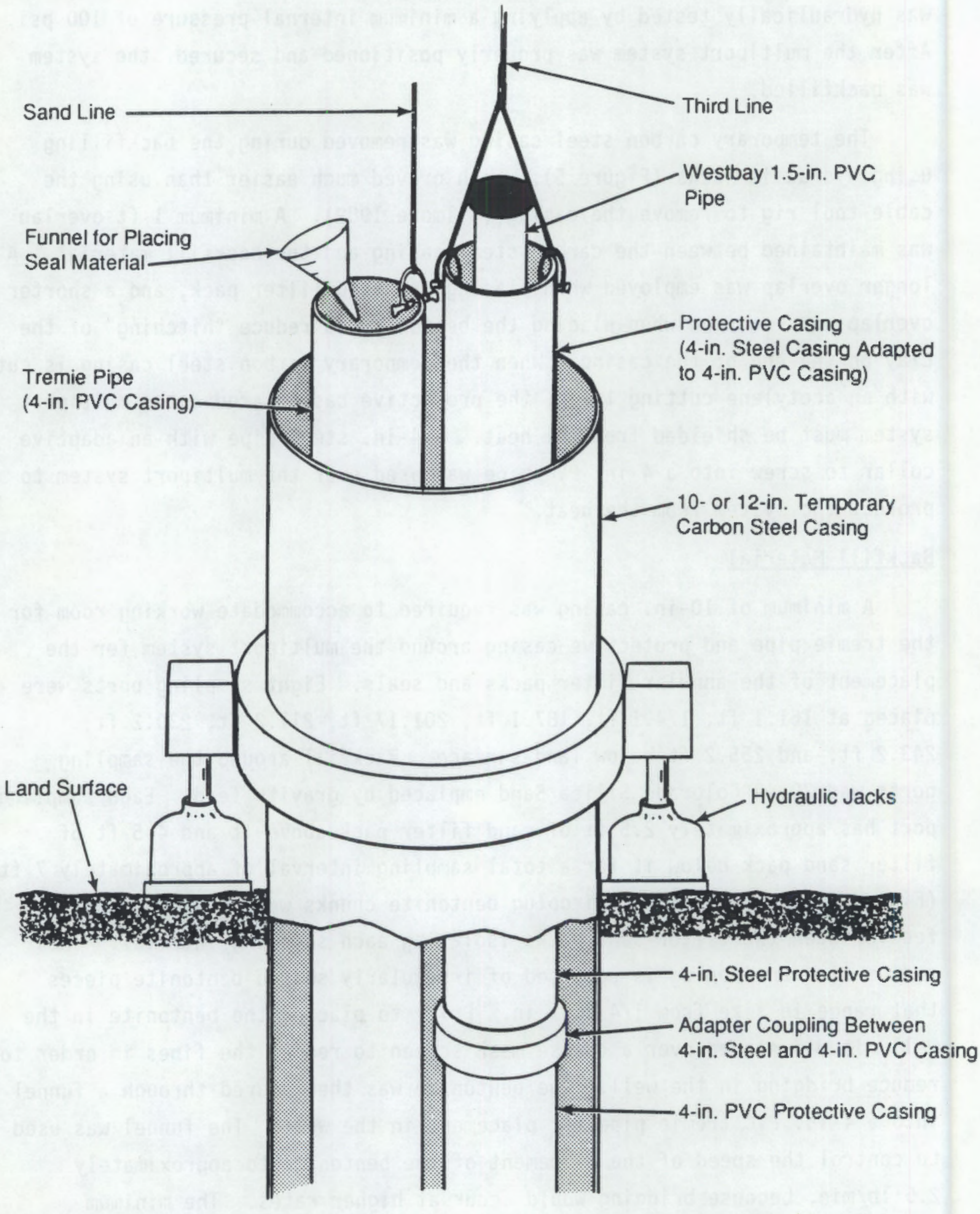

FIGURE 5. Completion Arrangement at the Well Head

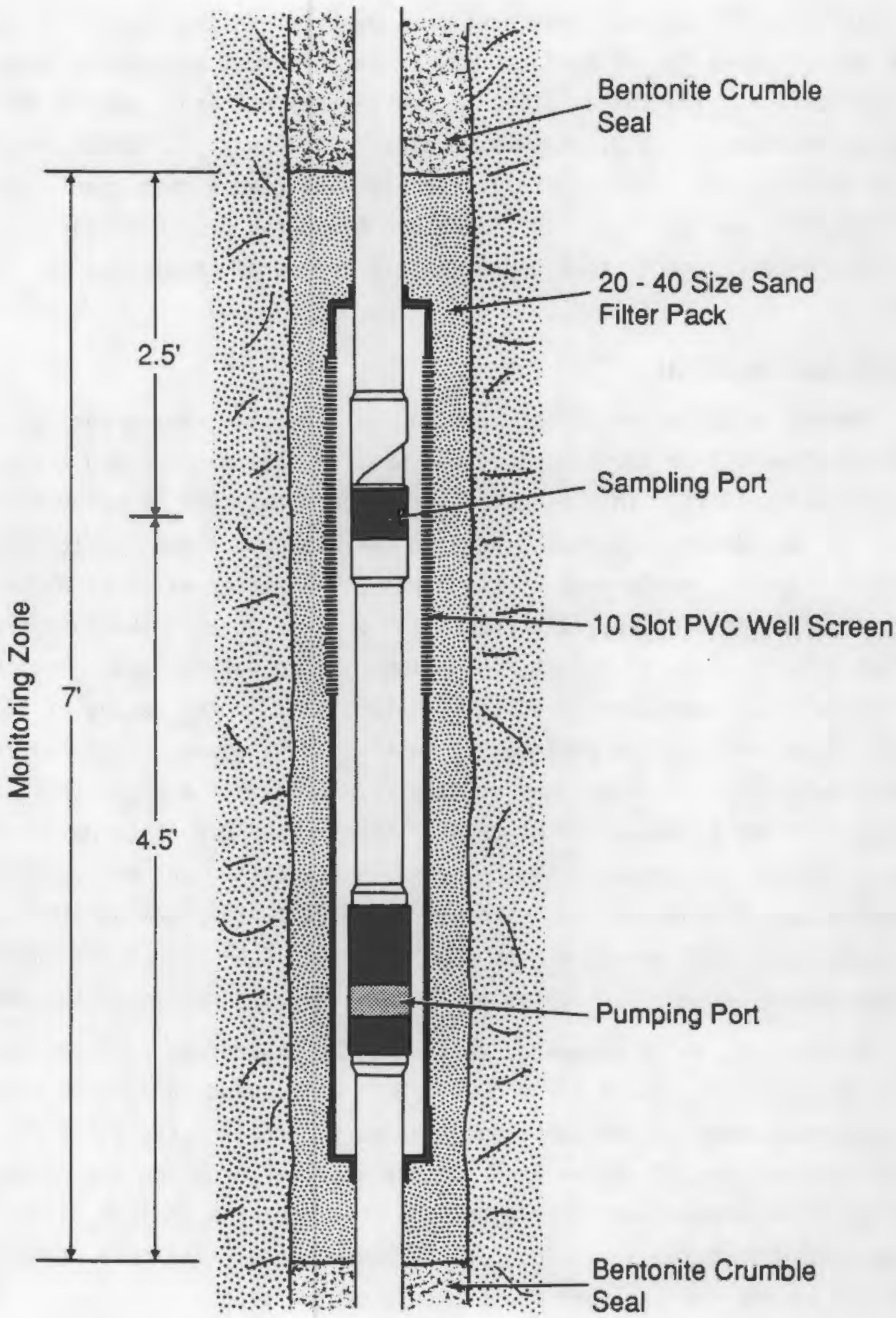

FIGURE 6. Multiport Monitoring Zone Configuration

The integrity of the seals was confirmed by pressure transducer readings at each port (Figure 7). A surface seal of cement grout was placed from 20 ft to the surface. The installation of the Westbay multiport system was initiated on December 8, 1988, and was completed on January 12, 1989, for a total of 23 working days. This installation time included 6 days spent retrieving and rewelding the 10-ft casing that broke below the ground surface. Excluding this repair time it took approximately 2 days of completion per sampling port.

Usable Sampling Ports

During installation of the multiport system, the casing was damaged when the tremie pipe used to place the annular seal was dropped and fell approximately 15 ft. This occurred at approximately 220 ft below land surface. It was determined that a hole in the casing was open to formational water during the development of the ports. The static water level inside the casing during development returned to 162.5 ft after each evacuation of the casing. The casing, if intact, is designed to be water tight. The location of the hole was indicated by a static water level in the casing of 162.5 ft, which is the same as the piezometric level that has been calculated for approximately 219 ft below land surface. In addition, a tight spot in the casing will not allow a tool of greater length than 0.8 ft to pass below the 219 ft level. Confirmation of the break in the casing was attempted using a downhole camera; however, the water in the multiport system at 219 ft was murky and the exact nature of the damage could not be seen. The casing does not provide a pathway for contaminant migration as a result of the damage.

At present, it is suggested that only the upper four ports at depths of 161.1 ft, 174.1 ft, 187.1 ft, and 201.17 ft below land surface be used for pressure measurements and sampling. The ports at 217.2 ft, 230.2 ft, 243.2 ft, and 255.2 ft below land surface are near or below the damage in the casing. The damage should first be repaired, and/or a smaller sized sampler (less than 0.8 ft long) be used for the lower ports. The hole in the casing will not affect the pressure measurements or sampling.

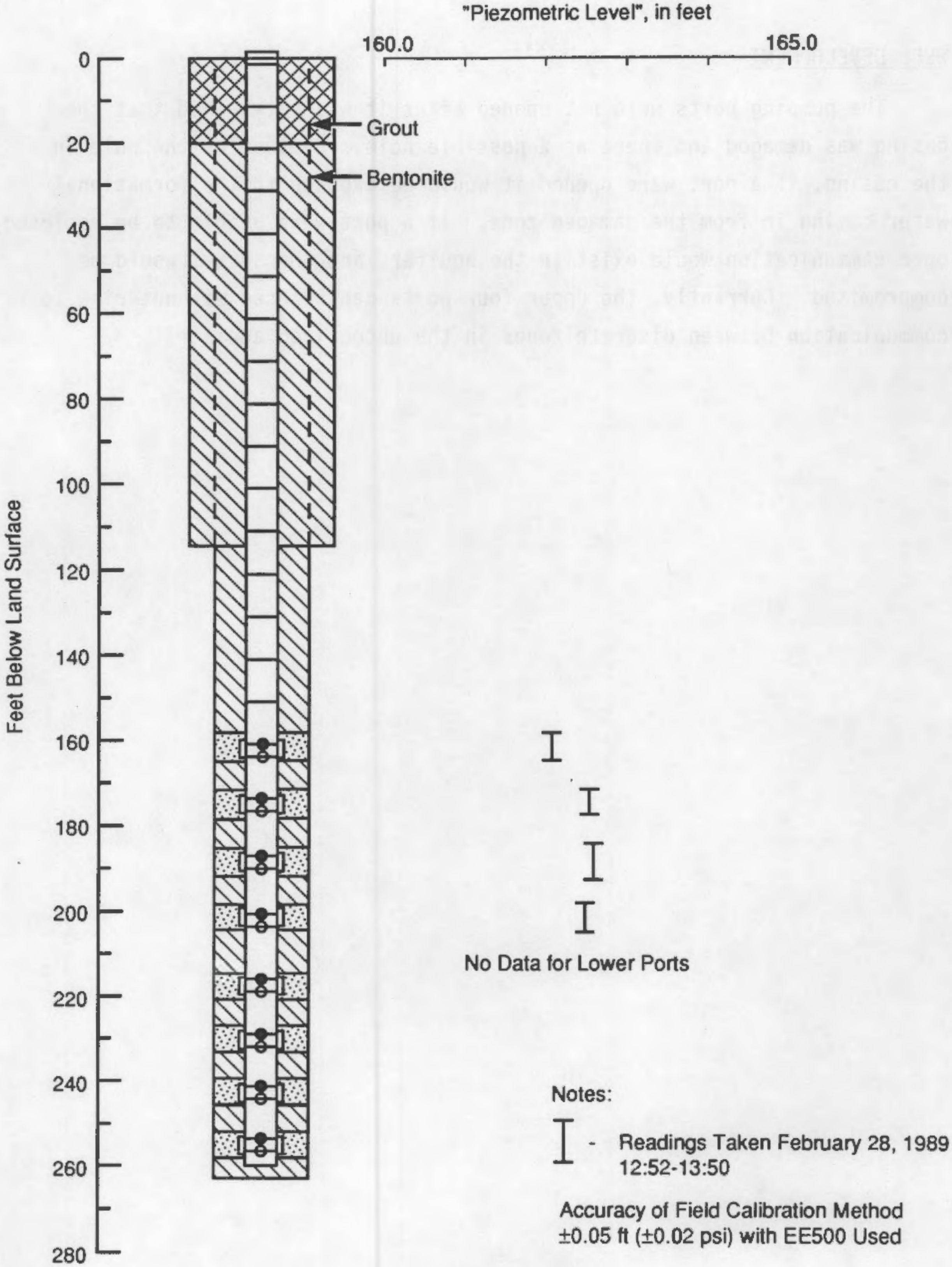

FIGURE 7. Pressure Transducer Readings

WELL DEVELOPMENT

The pumping ports were not opened after it was determined that the casing was damaged and there as a possible hole. Because of the hole in the casing, if a port were opened it would be exposed to the formational water coming in from the damaged zone. If a port were unable to be reclosed, open communication would exist in the aquifer, and the system would be compromised. Currently, the upper four ports can be used without risk to communication between discrete zones in the unconfined aquifer.

CONCLUSIONS AND RECOMMENDATIONS

The Westbay system is a versatile multiport system that provides data on vertical contamination and hydraulic head distribution representative of formation conditions from a single well. The system's major advantage is its modular design, allowing versatile monitoring configurations that can be easily customized to any location and installed in a single well. Another advantage is that the samples and pressure measurements are taken outside the access tube through the sampling port. This eliminates the need to purge the access tube during sampling; therefore, the sample's fluid chemistry is not altered as a result of degassing, oxidation, biogenic activity, and precipitation. The lag time on fluid pressure measurements is also reduced relative to a conventional standpipe well. Additionally, the multiport system allows the integrity of coupling valves, joints, and the annulus seals to be verified during installation and operation.

A major disadvantage is that the operation of the system is labor intensive and requires substantial training. The installation of the system in a backfilling operation is also more difficult than conventional standpipe well construction because the multiple screened intervals and the PVC construction require additional protection during backfilling. Very little maintenance can be performed after the system is installed by backfilling; therefore, should the system components fail, the life span of the system would be curtailed.

Studies on obtaining representative samples without purging the system are recommended prior to installing more multiport systems. Results from these studies could have an impact on installation methods. One method that is recommended for technical review is the installation of the system in a specially cased and screened well. This method would allow the removal and repair of the system after installation and would reduce the possibility of damage to the multiport system during well completion. Stainless steel 4-in. casing, screened at desired monitoring locations, would be placed in the well and backfilled. The multiport system would be placed inside this 4-in. stainless steel casing, using packers to isolate sampling intervals (Figure 8). According to Frank Patton, President and owner of Westbay Instruments Inc., a similar installation technique has been used successfully by the Orange County Water District, California.

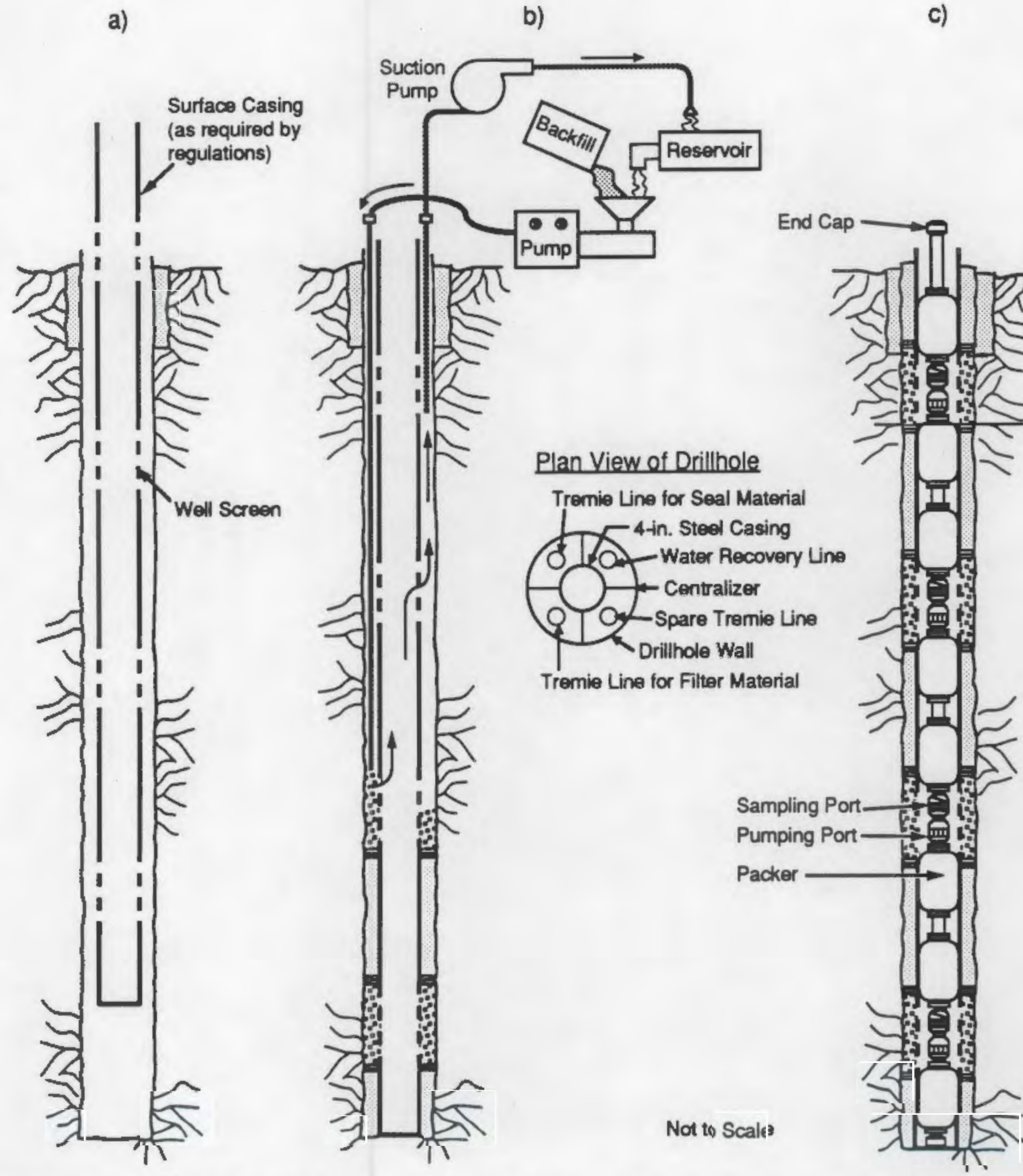

FIGURE 8. Installation of Multiport System in a Cased and Screened Well a) placing 4-in. stainless-steel casing in well; b) back filling around 4-in. stainless-steel casing; c) placing multiport system in well and inflating packers (after drawings provided by Westbay Instruments Inc.)

REFERENCES

Black, W. H., H. R. Smith, and F. D. Patton. 1986. "Multiple-Level Ground-Water Monitoring with the MP system." Paper presented at the Surface and Bore Hole Geophysical Methods and Ground Water Instrumentation Conference and Exposition, October 1986, Denver, Colorado.

Gilmore, T. J. 1989. The Installation of a Multiport Ground-Water Sampling System in the 300 Area. PNL-6910, Pacific Northwest Laboratory, Richland, Washington.

Graham, M. J., G. V. Last, and K. R. Fecht. 1984. An Assessment of Aquifer Intercommunication with B Pond-Gable Mountain Pond at the Hanford Site. RHO-RE-ST-12P, Rockwell Hanford Operations, Richland, Washington.

Tallman, A. M., K. R. Fecht, M. C. Marratt, and G. V. Last. 1979. Geology of the Separations Area, Hanford Site, South-Central Washington. RHO-ST-23, Rockwell Hanford Operations, Richland, Washington.

APPENDIX A

KAISER ENGINEERS HANFORD	SURVEY DATA REPORT		Request No. -891-033
Project/W.O. No. B 80919	Title B-Pond Monitoring Well		File No. WE11-119
KEH Job No. B 80919-11	Prepared By Gary B. Wagner	Date 03/15/89	Reviewer Grant F. Brazil

DESCRIPTION OF WORK	ACCEPTABILITY (Within Plan Tolerance)	DISTRIBUTION	
Surveyed new well located at B-Pond for horizontal and vertical positions. Calculated coordinates based on Plant, NAD27, and NAD83 datums. Vertical position based on Plant datum.	Yes ☐	Survey File	OR
	No ☐	Field Project File	
	NA ☒	T. Gilmore	1
	TBD by Requestor ☐	J. Rieger	1

SURVEY RESULTS AND COMMENTS

B-POND WELL

PLANT COORDINATES	N 42,509.0	E-42,304.3
NAD83 COORDINATES	N136,445.2	E576,997.5 (meters)
NAD27 COORDINATES	N447,706.3	E2,252,908.4

ELEVATIONS

Top of casing elevation	581.38
Top of brass cap elevation	579.03

KEH-159.1 (6-84)

WELL COMPLETION/INSPECTION REPORT

Specification No. B-47717-A-E Rev. No. 0	Well No. 699-43-41K Temp. Well No. WB-1
Project Westbay Multiport Ground Water Sampling	Coordinates N 42,529.0 E 42,705.3 (Plant Coordinates)
Location B-Pond	Casing Elev. 581.38 Ground Elev. 579.03
Drilling Co. Onwego	**DRILLING METHOD**
Driller Russ Varnes, Lenny Pulteney	Rotary Air N/A Mud N/A
Other (companies) Westbay	Cable Tool D 0-111' bls H 111'-263' bls
Geologist(s) K.R. Oster, S.M. Goodwin, S.S. Teel, T.G. Innes	Drilling Fluid 200 East Area Supply Water
	Other N/A

GEOPHYSICAL LOGGING

Sondes	Interval	Date
Natural Gamma	263'-1'	11/18/88
Neutron	263'-1'	11/18/88
Density	262'-0'	11/18/88

COMPLETION DATA

Drilled Depth 263' b.l.s.
Completed Depth 261.83'
Date Started 9/29/88
Date Completed 1/13/89
Static Water Level/Date 160.5'/12/6/88

AQUIFER TESTING

Type N/A
Length of Test
Volume Pumped
Drawdown
Date of Test

INSPECTION RESULTS

CLEANING

Inspection Method visual
Acceptance Criteria Spec. Secs. 6.1, 11.2

	Accept	Reject	Date
Drilling Tools/Rig	KRO		1/13/89
Temporary Materials	KRO		1/13/89
Permanent Materials	KRO		1/13/89

MATERIAL STORAGE/PACKING

Inspection Method visual
Acceptance Criteria Spec. Secs. 6.2, 6.3

	Accept	Reject	Date
Mtl. Handling/Storage	KRO		1/13/89
Material Packing	KRO		1/13/89

SCREEN

Type	Length	Slot Size
Westbay PVC - Slotted	1'	10
Westbay PVC - Slotted	1'	10

Depth(s) 255.73' - 254.73'; 243.73' - 242.73'
Inspection Method verify using steel tape
Acceptance Criteria Spec. secs. 6.D, 7.5
Accept KRO Reject Date 1/13/89

LUBRICANTS/ADDITIVES

Inspection Method visual
Acceptance Criteria Spec Sec 11.3

	Identify	Accept	Reject	Date
Additives	Drilling water	KRO		1/13/89
Lubricants	Chevron Poly FH	KRO		1/13/89

STRAIGHTNESS TEST

Inspection Method visual
Acceptance Criteria Spec. Sec. 7.5 D
Accept KRO Reject Date 12/11/88

CASING (permanent)

Type	Size	Placement
Westbay PVC (includes screened intervals)	1.5"	261.83'-Surface

Inspection Method verify using steel tape
Acceptance Criteria Spec. secs. 6.D, 7.5
Accept KRO Reject Date 1/13/89

WELL PROTECTION

Inspection Method visual
Acceptance Criteria Spec Secs 6, 7.5

	Accept	Reject	Date
Protective Posts	KRO		1/13/89
Locks			

ANNULAR SEAL

Inspection Method verify using steel tape
Acceptance Criteria Spec Sec. 7.5 G, H, I, O

Type	Interval	Volume	Accept	Reject	Date
Bentonite Plug Seal (medium)	262.35'-259'	3/4 bags (50 lbs ea)	KRO		12/12/88
Colorado Silica Sand (20-40 mesh)	259'-252'	4 bags (100 lbs ea)	KRO		12/12/88
Bentonite Plug Seal (medium)	252'-246.46'	3/4 bags (50 lbs ea)	KRO		12/14/88
Colorado Silica Sand (20-40 mesh)	246.46'-240.2'	4 bags (100 lbs ea)	KRO		12/14/88

Continued on Page 2

OTHER (initial if performed)

N/A Well Abandonment
Well Development
N/A Downhole TV Inspection
Complete As-Built Diagram, Driller's/Geologist's Logs

For all blanks mark N/A if not applicable.

WELL COMPLETION/INSPECTION REPORT

Specification No. B-U7717-A-E Rev. No. 0
Project Westbay Multiport Ground Water Sampling
Location B-Pond
Drilling Co. Onwezo
Driller Russ Vance, Lenny Bultena
Other (companies) Westbay
Geologist(s) K.R. Oster, S.M. Goodwin, S.S. Teel, T. Gilmore

Well No. 699-43-45k Temp. Well No. WB-1
Coordinates N 42 529.0 E 42 304.3 (Plant Coordinates)
Casing Elev. 581.38 Ground Elev. 579.03

SCREEN

Type	Length	Slot Size	Depth(s)
PVC - Slotted	1'	10	230.7' - 229.7'
PVC - Slotted	1'	10	217.69' - 216.64
PVC - Slotted	1'	10	201.67' - 200.67
PVC - Slotted	1'	10	187.65' - 186.65'
PVC - Slotted	1'	10	174.64' - 173.64'
PVC - Slotted	1'	10	161.63' - 160.63'

Inspection Method verify using steel tape
Acceptance Criteria Spec. secs. 6.0, 7.5
Accept KRO Reject ______ Date 1/13/89

ANNULAR SEAL

Inspection Method verify using steel tape
Acceptance Criteria spec sec. 7.5 G, H, I, Q

Type	Interval	Volume	Accept	Reject	Date
Bentonite Plug Seal (medium)	240.2' - 233.65'	5 bags (50 lbs ea)	KRO		12/15/88
Colorado Silica Sand (20-40 mesh)	233.65' - 227.3'	5 bags (100 lbs ea)	KRO		12/16/88
Bentonite Plug Seal (medium)	227.3' - 221.2'	4½ bags (50 lbs ea)	KRO		12/19/88
Colorado Silica Sand (20-40 mesh)	221.2' - 214'	4½ bags (100 lbs ea)	KRO		12/19/88
Bentonite Plug Seal (medium)	214' - 204.2'	6½ bags (50 lbs ea)	KRO		12/21/88
Colorado Silica Sand (20-40 mesh)	204.2' - 198.05'	5½ bags (100 lbs ea)	KRO		12/21/88
Bentonite Plug Seal (medium)	198.05' - 191'	5⅓ bags (50 lbs ea)	KRO		12/22/88
Colorado Silica Sand (20-40 mesh)	191' - 184'	6 bags (100 lbs ea)	KRO		12/22/88
Bentonite Plug Seal (medium)	184' - 178'	4¾ bags (50 lbs ea)	KRO		12/22/88
Colorado Silica Sand (20-40 mesh)	178' - 171'	9 bags (100 lbs ea)	KRO		12/27/88
Bentonite Plug Seal (medium)	171' - 165'	7 bags (50 lbs ea)	KRO		12/27/88
Colorado Silica Sand (20-40 mesh)	165' - 158	6 bags (100 lbs ea)	KRO		12/27/88
Bentonite Plug Seal (medium)	158' - 114'	38¼ bags (50 lbs ea)	KRO		12/28/88
Granular Bentonite Seal	114' - 20'	55 bags (100 lbs ea)	KRO		1/12/89
Cement Grout Seal	20' - .5'	17 bags (94 lbs ea)	KRO		1/12/89
Concrete Pad	.5' - +.33'	—	KRO		1/13/89

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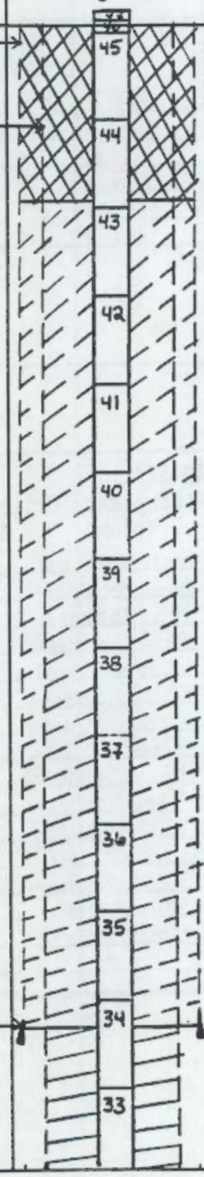
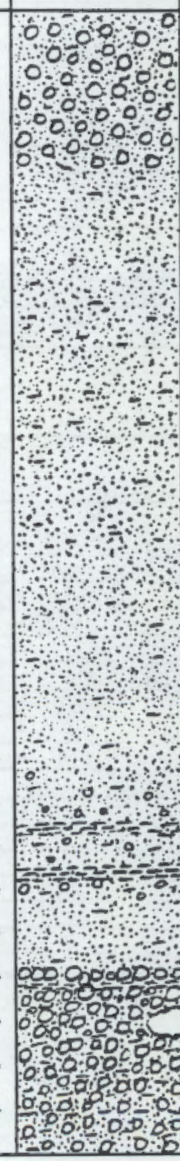
Pacific Northwest Laboratories

AS-BUILT DIAGRAM

Well Number (WB-1) Geologist Oster, Goodwin, Teel Page 1 of 3

Reviewed by V. L. McGhan Date 2-2-89





Construction Data: Description	Depth in Feet	Geologic/Hydrologic Data: Lithologic Description
116'6½" of 12" Carbon Steel Casing (Removed)	5	Gravelly Sand
	10	" "
258'6½" of 10" Carbon Steel Casing (Removed)	15	" "
	20	Sand (medium)
Cement Grout	25	" (Fine)
Granular Bentonite Top 20'	30	" (medium-fine)
	35	" "
	40	" (medium)
	45	" (medium-fine)
	50	" "
	55	" "
	60	" (medium)
	65	" "
	70	" "
	75	" (very fine)
	80	" (fine-veryfine)
	85	" (medium-fine)
	90	Slightly Gravelly Sand
	95	Sand (Medium-Fine) 8" Z lens @ 93'
	100	Slightly Gravelly Sand 1' Z lens @ 97'
	105	Sand (Course-Medium) SAG@109'
	110	Sandy Gravel (4" silt lens @ 111')
12" Drive Shoe	115	Boulder; Sandy Gravel
Enviroplug Medium Top 114'	120	Silty Sandy Gravel
	125	" " "
	130	" " "

A-1800-186 (3/87)

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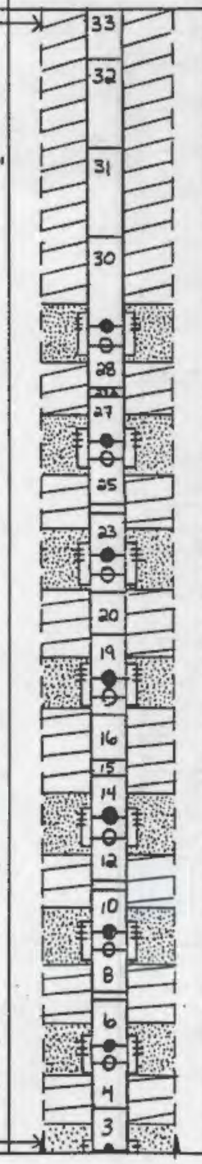
AS-BUILT DIAGRAM

Well Number (WB-1) Geologist Oster, Goodwin, Teel Page 2 of 3

Reviewed by [signature] Date 2-2-89



Construction Data: Description	Depth in Feet	Geologic/Hydrologic Data: Lithologic Description
258' 6½" of 10" Carbon Steel	~~130~~	Silty Sandy Gravel
Casing	~~135~~	" " "
Screens are 10 slot PVC	~~140~~	" " "
Sampling Pipe diameter is 1.5"	~~145~~	" " "
	~~150~~	" " "
20-40 Colo. Silica Sand Top 158'	~~155~~	" " "
Measurement Port 161.13'	~~160~~	Water table ≈158' Gravelly Silty Clay TOP OF silt/clay @ 159'
Enviroplug Medium Top 165'	~~165~~	Slightly Gravelly Sandy Silty Clay
20-40 Colo. Silica Sand Top 171'	~~170~~	Sandy Clayey Silt
Measurement Port 174.14'	~~175~~	Slightly Gravelly Clayey Sandy Silt
Enviroplug Medium Top 178'	~~180~~	" " " "
20-40 Colo. Silica Sand Top 184'	~~185~~	TOP OF GRAVELS @ 181.5' Silty Sandy Gravel
Measurement Port 187.15'	~~190~~	" " "
Enviroplug Medium Top 191'	~~195~~	" " "
20-40 Colo. Silica Sand Top 198.05'	~~200~~	Gravelly Silty Sand
Measurement Port 201.17'	~~205~~	" " "
Enviroplug Medium Top 204.2'	~~210~~	TOP OF SILT/CLAY @ 204.5' Slightly Gravelly Sandy Silt / Clay
20-40 Colo. Silica Sand Top 214'	~~215~~	BOULDERS @ 207' Sandy Silt/Clay
Measurement Port 217.19'	~~220~~	" "
Enviroplug Medium Top 221.2'	~~225~~	" "
20-40 Colo. Silica Sand Top 227.3'	~~230~~	Slightly Gravelly Sandy Silt / Clay
Measurement Port 230.2'	~~235~~	GRAVELLY SAND (G)SZC Δ GS / @ 233'
Enviroplug Medium Top 233.65'	~~240~~	GS Δ SG @ 235' SG Δ ZSG @ 239.5 SILTY SANDY GRAVEL
20-40 Colo. Silica Sand Top 240.2' Sampling Port 243.23'	~~245~~	VESICULAR BASALT @ 243' " " "
Enviroplug Medium Top 246.46'	~~250~~	" " "
20-40 Colo. Silica Sand Top 252' 10" Drive Shoe	~~255~~	

A-1800-186 (3/87)

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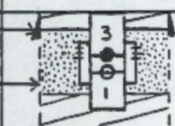
AS-BUILT DIAGRAM

Well Number (WB-11) Geologist Oster, Goodwin, Teel Page 3 of 3

Reviewed by V. L. McGhan Date 2-2-89

Construction Data: Description	Construction Data: Diagram	Depth in Feet	Geologic/Hydrologic Data: Diagram Litho.	Geologic/Hydrologic Data: Lithologic Description
10" Drive Shoe		255'		SILTY SANDY GRAVEL *
				OXIDIZED VESICULAR BASALT @ 257'-263'.
Borehole Wall		260'		GRAVELLY SILTY SAND
20-40 Colo. Silica Sand Top 252'		265'		Drilled Depth = 263' b.l.s.
Sampling Port 255.23'				
Enviroplug Medium Top 259'				
Bottom of Multiport System 261.87'				
Enviroplug Medium Bottom 262.35'				

A-1800-186 (3/87)

CASING LENGTH MEASUREMENT RECORD

Project: Battelle PNL Date: December 1, 1988 Project No.: 606-88

Location: BPond Drillhole No.: WB-1 Nominal B.O.H.: 163'

Casing Size/Type: 1.5" MP Measured By: Kurt Seedhouse

Section No.	Serial No.	Description	Nominal Length, ft.	Measured Length, ft. Top of Coupling	Cumulative Length, ft. Top of Coupling	Magnetic Collars
0	--	End Cap	1'	1' 4/16	.156	--
1	2117	5' Pumping Port	5'	5' 0"	5.16	4.16
2	4062	2' Measurement Port	2'	2' 1/16	7.16	--
3	--	5' Coupling	5'	5' 0"	12.16	--
4	2105	5' Pumping Port	5'	5' 0"	17.16	16.16
5	4063	2' Measurement Port	2'	2' 2/16	19.17	--
6	--	5' Coupling	5'	5' 1/16	24.18	--
7	--	1' Coupling	1'	1' 2/16	25.19	--
8	2112	5' Pumping Port	5'	5' 1/16	30.19	29.16
9	4060	2' Measurement Port	2'	2' 1/16	32.20	--
10	--	5' Coupling	5'	5' 1/16	37.20	--
11	--	1' Coupling	1'	1' 0"	38.20	--
12	2113	5' Coupling Port	5'	5' 0"	43.20	42.20
13	4061	2' Measurement Port	2'	2' 1/16	45.21	--
14	--	5' Coupling	5'	5' 1/16	50.21	--
15	--	2' Coupling	2'	2' 1/16	52.22	--
16	--	5' Coupling	5'	5' 1/16	57.22	--
17	2114	2' Pumping Port	2'	2' 0"	59.22	58.22
18	4058	2' Measurement Port	2'	2' 1/16	61.23	--
19	--	5' Coupling	5'	5' 1/16	66.23	--
20	--	5' Coupling	5'	5' 1/16	71.24	--
21	2103	2' Pumping Port	2'	2' 1/16	73.24	72.24
22	4059	2' Measurement Port	2'	2' 1/16	75.25	--
23	--	5' Coupling	5'	5' 1/16	80.25	--
24	--	1' Coupling	1'	1' 2/16	81.26	--
25	2106	5' Pumping Port	5'	5' 0"	86.26	85.26

CASING LENGTH MEASUREMENT RECORD

Project: Battelle PNL Date: December 1, 1988 Project No.: 606-88

Location: BPond Drillhole No.: WB-1 Nominal B.O.H.: 163'

Casing Size/Type: 1.5" MP Measured By: Kurt Seedhouse

Section No.	Serial No.	Description	Nominal Length, ft.	Measured Length, ft. Top of Coupling	Cumulative Length, ft. Top of Coupling	Magnetic Collars
26	4057	2' Pumping Port	2'	2' 0"	88.26	--
27	--	5' Coupling, 1' Coup.	5'	6' 1/16	94.27	--
27a	--	1' Correction	--	--	--	--
28	2104	5' Pumping Port	5'	5' 0"	99.27	97.27
29	4054	2' Measurement Port	2'	2' 1/16	101.27	--
30	--	10' Coupling	10'	10' 1/16	111.28	--
31	--	10' Coupling	10'	10' 0"	121.28	--
32	--	10' Coupling	10'	10' 1/16	131.29	--
33	--	10' Coupling	10'	10' 2/16	141.30	--
34	--	10' Coupling	10'	10' 2/16	151.31	--
35	--	10' Coupling	10'	10' 1/16	161.31	--
36	--	10' Coupling	10'	10' 0"	171.31	--
37	--	10' Coupling	10'	10' 0"	181.31	--
38	--	10' Coupling	10'	10' 0"	191.31	--
39	--	10' Coupling	10'	10' 0"	201.31	--
40	--	10' Coupling	10'	10' 1/16	211.32	--
41	--	10' Coupling	10'	10' 1/16	221.32	--
42	--	10' Coupling	10'	10' 0"	231.32	--
43	--	10' Coupling	10'	10' 1/16	241.33	--
44	--	10' Coupling	10'	10' 0"	251.33	--
45	--	10' Coupling	10'	10' 1/16	261.33	--

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