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Revision 0

Borehole Summary Report for the Installation of Two Groundwater Monitoring Wells at the 200-BP-5 Operable Unit, CY2007

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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Document Type: RPT Program/Project: SGW

J. Fetters
Freestone Environmental Services, Inc.

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TERMS

bgs	below ground surface
CCU	Cold Creek unit
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CSS	Colorado silica sand
FH	Fluor Hanford, Inc.
gpm	gallons per minute
HEIS	*Hanford Environmental Information System*
HP	horse power
ID	Identification
OD	outside diameter
OU	operable unit
RI/FS	remedial investigation/feasibility study
TD	total depth
WAC	*Washington Administrative Code*

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METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	Centimeters	centimeters	0.394	inches
feet	0.305	Meters	meters	3.281	feet
yards	0.914	Meters	meters	1.094	yards
miles	1.609	Kilometers	kilometers	0.621	miles
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
Acres	0.405	Hectares	hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
Ounces	28.35	Grams	grams	0.035	ounces
Pounds	0.454	Kilograms	kilograms	2.205	pounds
Ton	0.907	metric ton	metric ton	1.102	ton
Volume			**Volume**		
Teaspoons	5	Milliliters	milliliters	0.033	fluid ounces
Tablespoons	15	Milliliters	liters	2.1	pints
fluid ounces	30	Milliliters	liters	1.057	quarts
Cups	0.24	Liters	liters	0.264	gallons
Pints	0.47	Liters	cubic meters	35.315	cubic feet
Quarts	0.95	Liters	cubic meters	1.308	cubic yards
Gallons	3.8	Liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocuries	37	Millibecquerel	millibecquerel	0.027	picocuries

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1.0 INTRODUCTION

This report presents field generated records and summarizes field activities during the drilling and construction of two wells, 299-E27-155 (C5852) and 699-52-55A (C5861). These wells will serve as groundwater monitoring wells for the 200-BP-5 groundwater Operable Unit (OU) to support the 200-BP-5 OU remedial investigation/feasibility study (RI/FS). Figure 1-1 presents the locations of the two new monitoring wells included in this report along with key features of the area. Well C5852 is located in Waste Management Area C adjacent to the C Tank Farm in the central portion of the 200 East Area. Well C5861 is located in the 600 Area directly north of the 200 East Area, approximately 650 ft south of the existing wells 699-53-55A, 699-53-55B, and 699-53-55C. During drilling activities, soil and groundwater samples were collected to characterize soil and groundwater to support the 200-BP-5 OU RI/FS in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The soil and groundwater samples were also used to identify contaminants that may affect waste disposition and confirm the well design (sieve analysis of aquifer sediments within the screened intervals). A summary of the new wells are located in Table 1-1.

Table 1-1. Summary of the New Wells.

Well ID	C5852	C5861
Well Name	299-E27-155	699-52-55A
DOE/RL-2007-18 Well Identification	Well O	Well N
Purpose of well	Unconfined Aquifer Monitoring Well	Unconfined Aquifer Monitoring Well
General Location	Within 200 East Area, near C Tank Farms	North of 200 East Area (north side of Route 11A)

1.1 PURPOSE AND SCOPE

The purpose of this document is to compile and archive records, observations, and measurements associated with the drilling and construction of the two wells. This borehole summary report includes the field notes and forms prepared during the drilling and construction of the wells, well construction details, and well development data. Additional information described in the report includes subsurface geologic descriptions for each well, civil survey results, management of drilling-derived waste, and well acceptance. All drilling data are recorded in the English units in which they were measured. Well location data and drilling dates for the wells is given in Table 5-1.

Figure 1-1. Locations of New Monitoring Wells C5852 and C5861 Associated with the 200-BP-5 Operable Unit Remedial Investigation.

The purpose for each well is summarized in the *Sampling and Analysis Plan for FY 2006 200-BP-5 Groundwater Operable Unit Remedial Investigation/Feasibility Study* (DOE/RL-2006-55) and the *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit, Hanford Site, Richland, Washington* (DOE/RL-2007-18) as follows:

- Well C5852 (Figure 1-1) was drilled adjacent to the C Tank Farm to characterize the unconfined aquifer in the region of a technetium plume. The well is intended to resolve uncertainty regarding technetium inventory from past releases that have migrated into the groundwater at the C Tank Farm. This well will be used to evaluate vertical and horizontal distribution of technetium-99 and nitrate downgradient of Waste Management Area C.

- Well C5861 (Figure 1-2) is located south of well 699-53-55 and completed in unconsolidated sediments above the Elephant Mountain Member basalt unit. It is located at the edge of a paleo-channel created by apparent cataclysmic flood resulting in a "window" in the underlying basalt flow. It is intended to determine contaminant concentrations in the technetium and nitrate plumes in this area and determine aquifer hydraulic properties. This well will be used as an observation well during a pumping test performed in the future adjacent well C5862. Information from this test will be used to evaluate hydraulic properties near the basalt window and will provide information for a capture zone analysis for remediation of technetium-99. Other possible benefits from this well include providing additional control for the basalt surface, determining the concentrations of other radionuclide and chemical contaminants, and providing additional numerical results to refine statistical measurements for modeling risk of contaminant migration in the future.

Additional information on the purpose and planned sampling and well construction for wells C5852 and C5861 is contained in the *Description of Work for Calendar Year 2007 Installation of Two Groundwater Wells (299-E27-155, and 699-52-55A) at the 200-BP- 5 Operable Unit* (SGW-34422).

1.2 BACKGROUND

Beginning in the early 1940s and continuing for nearly five decades, large volumes of radioactive waste and non-radioactive dangerous wastes were stored and disposed of in various waste facilities located within the 200-BP-5 OU. Also, large volumes of process water were infiltrated utilizing cribs, trenches, and ponds. Liquid waste discharges to the vadose zone resulted in significant groundwater recharge which raised the water table and increased groundwater flow rates to the north and the southeast.

In 1989, the Hanford Site was listed on the National Priorities List pursuant to CERCLA, including the 200 East Area. To address CERCLA groundwater issues in the 200 East Area, the 200-BP-5 and 200-PO-1 groundwater OUs were established, which together cover the entire 200 East Area as well as land north, south and east. Approximately 95 existing monitoring wells comprise the 200-BP-5 OU groundwater monitoring network. Fifteen new groundwater wells

were proposed to support the 200-BP-5 OU RI/FS (DOE/RL-2007-18). Wells C5852 and C5861 are the fourth and fifth of these 15 wells to be installed.

2.0 DRILLING, SAMPLING AND WELL CONSTRUCTION ACTIVITIES

This section summarizes the drilling, sampling and well construction activities associated with wells C5852 and C5861. Well drilling, sampling and construction details common to these wells are summarized in Section 2.1. Well-specific information is summarized in Section 2.2.

2.1 GENERAL INFORMATION

The following summarizes activities and information common to the two wells. The wells were constructed to Washington State standards detailed in WAC 173-160 ("Minimum Standards for Construction and Maintenance of Wells"). Well construction activities were recorded and borehole geology was logged in accordance with Fluor Hanford, Inc. (FH) procedures: GRP-EE-02-14.1, "Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings"; and GRP-EE-01-7.0 "Geologic Logging."

- **Drilling** – Both boreholes were drilled with a cable tool drill rig, utilizing a combination of drive barrel and hard tool drilling methods. Each well was drilled using 11.75-in outer diameter (OD) threaded and nominal 8-in OD threaded casing. A reduction in casing size was preformed to ease the removal of the temporary casing during well construction. All temporary casing was removed during well construction.

- **Archive Lithologic Sampling** – Grab samples were collected from the drill cuttings of each well for geologic description and sample archive requirements. The samples were collected at 5-ft intervals and recognizable changes in lithology. Each archive sample was placed in a labeled pint-sized glass jar and sequential chip tray compartment. The jars and chip trays were delivered to the geologic sample archive storage building managed by Pacific Northwest National Laboratory. Digital photographs of each archive sample were taken in the field and used to construct a photographic log for each well. Borehole geologic logs and photographic logs for each well are presented in Appendices A and B.

- **Split-spoon sampling** – Split-spoon samples were collected from each borehole at predetermined depths and intervals. These samples are intended to support various chemical and physical soil analyses in support of the 200-BP-5 OU RI/FS. These samples were collected using a 4-in. diameter split-spoon sampler containing four 6-in. long Lexan or stainless steel liners. The split-spoon sample liners were capped, taped, and labeled in accordance to FH procedures. The length of the split-spoon sampler is 2.5 ft (including shoe). The split-spoon was driven 2.5 ft or until refusal. Split-spoons used for chemical analysis were decontaminated prior to sample collection. See Section 2.2 for specific split-spoon sample depths for each well. Split-spoon sample depths and *Hanford Environmental Information System* (HEIS) database sample identification (ID) numbers are presented in Appendices A and B.

- **One-quart Jar sampling** – Quart-size grab samples were collected at predetermined depths in addition to archive grab samples. Quart-sized grab samples were intended to support various geochemical and physical soil analyses in the development of modeling parameters for the 200-BP-5 OU RI/FS. Quart jar sampling depths and HEIS numbers are presented in Appendices A and B.

- **Groundwater Sampling** – Groundwater samples were collected at depth discreet intervals generally corresponding to split-spoon sample depths. All groundwater samples were collected with a submersible 5 horsepower (HP) pump capable of pumping 5 to 25 gallons per minute (gpm). Samples collected were analyzed for saturated zone contaminants of potential concern identified in DOE/RL-2007-18.

- **Geophysical Logging** – Each borehole was logged using S.M. Stoller Corporation's spectral gamma logging system and neutron moisture logging system. Because logging methods are limited to one string of casing, logging was conducted prior to sizing down temporary casing at each well and again after total depth (TD) was reached.

- **Radiological Field Screening** – The drilling of each borehole was classified as a low risk activity based on previous drilling and sampling activities. Based on this classification, morning and afternoon radiological surveys were conducted during drilling. Although the drilling of both wells was considered low risk, full time radiological field screening was provided at well C5852 for the first 40 ft of drilling due to the proximity of UPR-200-E-86 and contamination area 200-E-135. A radiological control technician performed the radiological surveys using standard radiological field screening instruments. No radiological field measurements above background levels were reported.

- **Air Monitoring for Volatile Organic Chemicals** – Air quality monitoring was performed twice daily (morning and afternoon) to verify that the drillers' breathing zone remained free of volatile organic contamination. The breathing zone near the wellhead, the fresh drill cuttings, and geologic samples were surveyed for volatile organics using a photoionization detector. No field measurements above background levels were reported by the industrial hygiene technician during the well drilling activities.

- **Well Construction Materials** – Each well was constructed using 4-in. nominal diameter, schedule 10 Type 304L stainless steel threaded casing. A Type 304L stainless steel continuous wire wrap well screen was utilized at each well. Screen size (slot size) and length varied depending on conditions in the interval to be screened. Each well screen was equipped with a 3 ft long sump consisting of 4-in. diameter stainless steel casing with a stainless steel bottom cap. Specific well construction materials are summarized in Section 2.2

- **Filter Pack and Backfill** – The filter pack is intended to fill the annular space between the borehole wall and the screen. Measurements were taken during construction to ensure that overlap was maintained, preventing the formation from caving against the screen. The primary filter pack surrounding the screen for each well consists of 10-20

mesh Colorado silica sand (CSS). Specific well construction materials are summarized in Section 2.2

- **Annular Seal** - The annular seal for wells C5852 and C5861 consists of 3/8-in. bentonite pellets placed directly above the primary sand pack. The annular surface seal consisted of granular bentonite crumbles to approximately 10 ft below ground surface (bgs) and Portland cement grout directly above the granular bentonite to ground surface.

- **Surface Completion** – The above ground stickup of the 4-in. diameter permanent casing at well C5852 is protected by 6-in. nominal diameter stainless steel casing embedded into a 6-in. thick, 4 ft by 4 ft concrete pad placed around the well. The wellhead is protected by 4-in. diameter by 3 ft tall steel posts at each corner of the cement pad. Well C5861 was completed with a flush mount well head.

- **Well Development** - Well development was performed in two stages, during and after well construction. Initial well development consisted of surging the filter pack with a dual-flange surge block. Surging the well settled the filter pack around the well screen, eliminating any void spaces, and began to pull fines that were produced during drilling. The second stage of well development consisted of pumping the well until water quality parameters (conductivity, pH and temperature) stabilized and turbidity declined to less than 5 nephelometric turbidity unit. Final well development was performed with a 5 HP or Redi-Flo 2&4 submersible pump.

2.2 WELL-SPECIFIC INFORMATION

This section summarizes the activities and information specific to each well location, such as sample depths, geologic observations and other unique well-specific activities.

2.2.1 Well C5852

Well C5852 is located adjacent to the C Tank Farm in the central portion of the 200 East Area, at the coordinates and elevation presented in Table 5-1.

2.2.1.1 Drilling

Drilling of well C5852 was initiated on September 26, 2006 utilizing a cable-tool drill rig and drive barrel methods to advance the borehole to the surface of the Elephant Mountain Basalt (366.0 ft bgs). The borehole was advanced to the total drill depth of 340.0 ft bgs (4 ft into the basalt) on October 25, 2007, utilizing a 7-in. OD hard tool bit. Temporary 11.75-in. OD threaded casing was advanced to 130 ft bgs and nominal 8-in casing was utilized from 130 ft bgs to the surface of the Elephant Mountain Basalt. Drive-barrel drilling through the unsaturated zone was completed without the aid of drilling fluid.

Saturated soils were first encountered during drilling at approximately 282.5 ft bgs on October 15, 2007. The static water level was measured at 281.26 ft bgs on October 16, 2007.

2.2.1.2 Sampling

Depths and HEIS numbers for sediment and groundwater samples collected from C5852 are included in Appendix A. Fourteen split-spoon samples were collected from predetermined depths beginning at 271 ft bgs to the top Elephant Mountain Basalt at 336 ft bgs. Three split-spoon samples were collected in the unsaturated zone and 11 were collected in the saturated zone. Thirty-five quart sized grab samples were collected every 2.5 ft beginning at 270 ft to 335.5 ft bgs (top of basalt), 13 samples were collected in the unsaturated zone and 22 samples were collected in the saturated zone.

Groundwater samples were collected utilizing a 5 HP submersible pump from the cased borehole. Four groundwater samples were collected in the unconfined aquifer at four discrete depths: 292 ft bgs, 307.5 ft bgs, 327.5 ft bgs, and 336 ft bgs (top of basalt). Each groundwater sample was collected with the sample pump intake placed approximately 3 ft off the bottom of the borehole.

2.2.1.3 Well Construction

Prior to well construction, the borehole passed a deviation test. Well construction information for well C5852 is summarized in Table 2-1.

The 4-in. OD permanent casing was placed from 1.72 ft above ground surface to 300.46 ft bgs. A 35 ft 20-slot screen was placed from 300.46 to 335.46 ft bgs with a 3 ft stainless steel sump placed from 335.46 to 338.46 ft bgs and. A 6-in. diameter stainless steel protective casing was placed to 3 ft above ground surface.

The surface seal is comprised of Portland cement from ground surface to 10.01 ft bgs. Granular bentonite was placed from 10.01 to 279.0 ft bgs. Approximately 5 ft of 10-20 mesh CSS was placed from 279.0 to 284.45 ft bgs. Coated 3/8-in. bentonite pellets were placed directly above the primary filter pack from 284.5 to 294.25 ft bgs. The primary filter pack, consisting of 10-20 mesh CSS, was placed from 294.25 to 340 ft bgs.

2.2.1.4 Final Well Development

Final well development was conducted on November 12, 2007 following well completion. Final well development was performed on the lower and upper portions of the screen with the pump intake set at approximately 331.03 ft bgs and 305.58 ft bgs, respectively. Development produced approximately 3,700 gallons of water. Well development was performed in accordance with GRP-EE-01-6.3 ("Well Development and Testing"). Results of the well development are summarized in Section 4.0.

2.2.2 Well C5861

Well C5861 is located in the 600 Area directly north of the 200 East Area, approximately 650 ft south of the existing wells 699-53-55A, 699-53-55B, and 699-53-55C. Surveyed coordinates and elevation are presented in Table 5-1.

2.2.2.1 Drilling

Drilling of well C5861 was initiated on November 20, 2007 utilizing a cable-tool drill rig and drive barrel methods to advance the borehole to the surface of the Elephant Mountain Basalt (177.2 ft bgs). The borehole was advanced to the total drill depth of 183.32 ft bgs (6.12 ft into the basalt) on January 4, 2008, utilizing a 7-in. OD hard tool bit. Temporary 11.75-in OD threaded casing was advanced to 74 ft bgs and nominal 8-in casing utilized from 74 ft bgs to the surface of the Elephant Mountain Basalt (177.2 ft bgs). Drive-barrel drilling through the unsaturated zone was completed without the aid of drilling fluid (water). Due to the thin aquifer and heaving sand, approximately 440 gallons of potable water was added to the borehole during hard tool drilling in the basalt.

On December 13, 2007, the hard tool bit separated from the drill stem at approximately 177.7 ft bgs. Initial attempts to fish the hard tool out of the borehole were unsuccessful. It was determined that the hard tool was either wedged in the casing or sediments had settled around the hard tool thereby locking it in the casing. On December 26, 2007 the decision was made to pull the casing out of the borehole with the hard tool inside of it. Retrieval of both the casing and hard tool were successful. Redrilling of the borehole began the next day and TD was reached January 4, 2007.

Saturated soils were first encountered during drilling at approximately 177 ft bgs on December 10, 2007. Static water level was first measured on December 11, 2007 at 173.5 ft bgs.

2.2.2.2 Sampling

Depths and HEIS numbers for sediment and groundwater samples collected from C5861 are included in Appendix B. One split-spoon sample was attempted near the top of the unconfined aquifer from 174 to 176.5 ft bgs. A large cobble was encountered during the split-spoon attempt, damaging the split-spoon, preventing the removal of the shoe. The contents of the split-spoon were emptied into a clean stainless steel bowl. Twelve quart sized grab samples were collected every 2.5 ft beginning at 145 ft to 175 ft bgs, 10 samples were collected in the unsaturated zone and 2 samples were collected in the saturated zone.

No groundwater samples were collected at well C5861 during drilling and well development or immediately after permanent pump installation.

2.2.2.3 Well Construction

Prior to well construction, the borehole passed a straightness test. A summary of the well completion for well C5861 is described in Table 2-1.

The 4-in. OD permanent casing was placed from 1.1 ft bgs to 169.8 ft bgs. A 10 ft 20-slot screen was placed from 169.8 to 179.8 ft bgs with a 3 ft stainless steel sump placed from 179.8 to 183.1 ft bgs and. A 6-in diameter stainless steel protective casing with a locking cap was placed from 0.5 to 3.5 ft bgs and a 12-in steel protective casing from ground surface to 1.5 ft bgs. Well C5861 was constructed with a flush mount monument due to its location.

The surface seal is comprised of Portland cement from ground surface to 10.0 ft bgs. Granular bentonite was placed from 10.0 to 156.0 ft bgs. Coated 3/8-in. bentonite pellets were placed directly above the primary filter pack from 156.0 to 160.0 ft bgs. The primary filter pack, consisting of 10-20 mesh CSS, was placed from 160.0 to 183.3 ft bgs.

Well development was performed following construction of the well over a two day period. Development was completed utilizing both a variable speed pump and bailer. Due to poor aquifer conditions less than 20 gallons of water were removed from the borehole and a final nephelometric turbidity unit value of 128 was reached. Given the aquifer conditions, the project scientist decided that no further development would be performed. Well development was completed on January 22, 2008 and was performed in accordance with GRP-EE-01-6.3. Results of the well development are summarized in Section 4.0.

Table 2-1. Well Construction Summary.

Well Construction Materials	Well Name / ID	
	299-E27-155/C5852	699-52-55A/C5861
Total Depth Drilled (ft bgs)	340.0	183.3
Water Level (ft bgs)/ Date Measured	280.92 (11-6-07)	173.75 (1-22-08)
Permanent 4-in. Diameter screen and casing		
Top of Screen (ft bgs)	300.46	169.8
Bottom of Screen (ft bgs)	335.46	179.8
Screen Length (ft)	35.0	10.0
Screen Size	20 (0.020")	20 (0.020")
Sump (ft)	3	3.3
Top of Casing	1.72 (ft ags)	1.1 (ft bgs)
Top of 6-in. protective casing	2.72	Ground surface
Annular Seal		
Surface Seal (ft bgs)	0-10.0	0-10.0
Granular Bentonite Seal (ft bgs)	10.0-279.0	10.0-156.0
10-20 CSS	279.0-284.5	NA
3/8-in. Bentonite Pellet Seal (ft bgs)	284.5-294.25	156.0-160.0
Primary Filter Pack		
10-20 CSS	294.25-340.0	160.0-183.3

Notes:
ags = above ground surface
bgs = below ground surface
CSS = Colorado silica sand
NA = not applicable

3.0 GEOLOGY OF 200-BP-5 OPERABLE UNIT

The following section summarizes the general geology in the area surrounding the two new monitoring wells.

3.1 STRATIGRAPHIC SETTING

The stratigraphy of this portion of the 200-BP-5 OU consists of unconsolidated sedimentary deposits that overlie the older Columbia River Basalt Group flood basalts and associated sedimentary interbeds. The principal stratigraphic units previously noted within and adjacent to 200 East Area of the Hanford Site, from youngest to oldest, are:

- Holocene surficial deposits (fill and eolian deposits) - Typically includes eolian (windblown) sands as well as construction backfill which typically consist of poorly sorted gravelly sands or sandy gravels of local Hanford formation origin.

- Hanford formation – Sediments deposited by cataclysmic floods from glacial Lake Missoula, pluvial Lake Bonneville, and other ice-margin dammed lakes. The Hanford formation has been subdivided into an upper gravelly unit (H1), a sand-dominated unit (H2), and a lower gravel-dominated unit (H3) (RPP-23748, *Geology, Hydrogeology, Geochemistry, and Mineralogy Data Package for the Single-Shell Tank Waste Management Areas at the Hanford Site*)

- Cold Creek unit (CCU) – Cataclysmic flood and overbank deposits occurring between the late Pliocene and early Pleistocene. The CCU has been described to include up to two separate facies. A sequence of sandy gravel to gravelly sand occurs beneath a thick (approximately 30 ft) silt-dominated facies. These two facies are found directly above the top of upper-most basalt unit or directly above the Ringold Formation. The gravel sequence represents either cataclysmic flood deposits or ancestral Columbia River deposits. It is thought that the silt rich facies may represent over bank flood plain alluvium from the ancestral Columbia River or eolian loess (HNF-5507, *Subsurface Conditions Description of the B-BX-BY Waste Management Area*). Where the silt unit is absent, the gravel sequence is indistinguishable from similar-appearing facies of the overlying Hanford formation H3 unit described below, and it is referred to as the Hanford formation lower gravel/CCU undifferentiated or "H3/CCU undifferentiated" (HNF-5507).

- Ringold Formation - The late Miocene to mid-Pliocene Ringold Formation consists of river channel sand and gravel deposits, along with overbank sand and silt deposits. The Ringold Formation thins or is absent in parts of the 200 East Area and areas north to Gable Mountain. Its absence in the Gable Gap area (between Gable Butte and Gable Mountain) is attributed to erosion by the Missoula Floods and/or the ancestral Columbia River (RHO 1978, *Geology of Gable Mountain – Gable Butte Area*). Reworked Ringold sediments (mainly gravels) are considered part of the overlying unit(s).

- Elephant Mountain Member basalt (Columbia River Basalt Group) - The Elephant Mountain Member of the Columbia River Basalt Group is composed of two basalt flows and is the uppermost basalt unit beneath the 200-BP-5 OU.

Three of these stratigraphic units are present at the two borehole locations included in this report, including Holocene surficial deposits, Hanford formation sediments, and the Elephant Mountain Member basalt.

3.2 BOREHOLE GEOLOGY

This section describes the general geologic characteristics and stratigraphic units (when evident) observed during the drilling of boreholes for wells C5852 and C5861. Geologic logs were prepared in accordance with FH procedure GRP-EE-01-7.0 and are included in Appendix A through B.

3.2.1 Borehole C5852

Two major stratigraphic units were encountered while drilling borehole C5852; the Hanford formation and the Elephant Mountain Member basalt. The top of the Elephant Mountain Member basalt was encountered at 336 ft bgs. The vadose zone at C5852 is approximately 336-ft thick and the unconfined aquifer is approximately 55-ft thick.

3.2.1.1 Surficial Deposits and Hanford formation, H2

The H2 unit at this location is overlain by 3 ft of a combination of fine to medium grained eolian sand and fill. The sand dominated facies of the Hanford formation (H2) was identified from 3 to 270 ft bgs; the H1 unit is not present at C5852. Sands in the H2 unit are very fine to very course grained, and generally composed of equal amounts of basalt and quarts/feldspar; however, zones of very fine to medium grained quartz/feldspar rich sands (>60%) were noted throughout the H2 unit. Gravelly sand interbeds were noted throughout the entire H2 unit, occurring between 3 to 11, 40 to 45, 69 to 75, 185 to 187, 190 to 193, 230 to 237, and 258 to 263 ft bgs. Gravels in these interbeds are generally composed of equal amounts of basaltic and felsic clasts ranging from very fine pebbles to large cobbles (2 to 256 mm) in size and are sub-rounded to rounded. Several layers with increased silt content were noted between 125 to 129, 144 to 153, 219 to 223, 245 to 250, and 260 to 280. Zones with increased silt content were unconsolidated, light grayish brown to grayish brown (10yr 6/2 to 10yr 5/2), and reacted moderately to very strong to 10% dilute HCl.

3.2.1.2 Hanford formation, H3

The H3 unit of the Hanford formation consisted predominately of sandy gravel to gravel from 270 to 336 ft bgs (the top surface of the Elephant Mountain Basalt). Gravels at C5852 are in general composed of greater than 60% basalt, sub-rounded to rounded, and range in size from very fine pebble to large cobble (2 to 256 mm). Zones of increased silt content, up to 40%, were encountered between 275 to 280 and 332 to 335 ft bgs. A thin, approximately 1 ft layer, of

gravelly silt was encountered from 335 to 336 ft bgs. This layer consisted of up to 70% silt and 30% fine pebbles and was very dark gray (10yr 3/1) with notable amounts of dark yellowish brown mottling (10yr 3/6). The H3 sediments found at C5852 showed not cementation and did not react with 10% dilute HCL.

3.2.1.3 Elephant Mountain Basalt Member

The Elephant Mountain Member basalt is the uppermost basalt member in the project area. At borehole C5852, this basalt was encountered at 336 ft bgs. Drilling was terminated 4 ft into the basalt at 340 ft bgs. Cuttings in the upper portion of the flow did not show red/reddish brown oxidized surfaces or vesicles.

More detailed descriptions of C5852 findings are included in the borehole and photographic logs presented in Appendix A.

3.2.2 Borehole C5861

Two stratigraphic units are encountered in borehole C5861; the Hanford formation and the Elephant Mountain Member basalt. The Hanford H1 was encountered from 3 to 123 ft bgs. The Hanford H2 sand dominated unit was encountered from 123 to 177.2 ft bgs. The top of the Elephant Mountain Member basalt was encountered at 177.2 ft bgs. The vadose zone in this area is approximately 177-ft thick and the unconfined aquifer is approximately 3.7-ft thick.

3.2.2.1 Hanford formation (H1)

The upper facies of the Hanford formation (H1) was overlain by approximately 3-ft of fine to medium grain quartz/feldspar rich eolian sands. The upper gravel dominated facies of the Hanford formation, identified from 3 to 123 ft bgs, consisted primarily of silty sandy gravel to gravel; however an 11-ft thick zone of basaltic sand was present from 19 to 30 ft bgs. Gravels are composed of up to 70% basalt ranging in size from very fine pebbles to large cobbles (2 to 256 mm) and are sub-rounded to rounded. Sands ranged from very fine to very course and in general were composed of >50% basalt. A weak cementation was encountered in gravels at 110 ft bgs. Reaction with 10% dilute HCL varied from non-reactive to moderately reactive throughout the H1 unit at C5861.

3.2.2.2 Hanford formation (H2)

The sand dominated facies of the Hanford formation (H2) was identified from 123 to 177.2 ft bgs. Although the H2 unit consists primarily of sand, varying amounts of both silt and gravels were noted. The lithology of the upper portion of the H2 unit (123 to 142 ft bgs) contained greater amounts of gravels, ranging from gravely sand to gravelly silty sand. Sands present at C5861 are angular very fine to very course grained, and generally composed of equal amounts of basalt and quarts/feldspar. Gravels are composed of equal amounts of basaltic and felsic clasts ranging from very fine pebbles to course pebbles (2 to 32mm). Clasts are rounded. An 8-ft thick silt layer was present from 147 to 155 with notable rust red mottling present from 151 to 153 ft bgs. Below the silt layer, sand to silty gravelly sand is present, with decreased

amounts of gravels (<20%), to the surface of the basalt. Zones of moderate cementation were present between 123 to 130 and 142 to 145 ft bgs. Reaction with 10% diluted HCL varied from very weak to moderately strong throughout the H2 unit.

3.2.2.3 Elephant Mountain Basalt

The Elephant Mountain Member basalt is the uppermost basalt member in the project area. At borehole C5861, basalt was encountered at 177.2 ft bgs. Drilling was terminated 6.1 ft into the basalt at 183.3 ft bgs. Cuttings in the upper portion of the flow did not show red/reddish brown oxidized surfaces or vesicles.

More detailed descriptions of C5861 findings are included in the borehole and photographic logs presented in Appendix B.

3.3 HYDROGEOLOGY

The vadose zone in the project location is composed of a thin layer backfill material and unconsolidated sands and gravels of the Hanford formation. The unconfined aquifer beneath the project area is also contained within the Hanford formation sediments directly overlying the upper-most basalt unit. The unconfined aquifer thickness in the vicinity of well C5852 is about 55 ft and approximately 3.7 ft at well C5861.

4.0 WELL DEVELOPMENT

Each well was developed in two stages. Initial well development consisted of surging the filter pack with a dual-flange surge block. Surging the well settled the filter pack around the well screen, eliminating any void spaces, and began to pull fines that were produced during drilling. Following well completion, a temporary submersible pump was placed in each well (5 HP in C5852 and a Redi Flo 2&4 in C5861). Each well was pumped until water quality parameters (conductivity, pH and temperature) stabilized and turbidity declined to less than 5 nephelometric turbidity units. During these development pumping tests, the water level in the pumping well was monitored using a pressure transducer. A summary of the final field water quality data is summarized in Table 4-1.

Table 4-1. Well Development Data Summary.

Well Name/ Well ID	Static Water Level (ft bgs)	Date	Intake Depth (ft bgs)	Pumping Duration (minutes)	Final Turbidity (NTU)	Final Conductivity (µS/cm)	Final Temp (°C)	Average Flow Rate (gpm)	Final Drawdown (ft)	Total Gallons Pumped
299-E27-155 /C5852	281.19	11/12/07	U 305.03 L 331.03	U 123 L 80	U 1.93 L 2.66	U 0.681 L 0.620	U 18.4 L 18.6	U 30 L 25	U 0.078 L 0.010	U 1500 L 2200
699-52-55A /C5861	173.75	1/18/08 1/22/08	U 177.90 L 181.55	U 116 L 30	U >128 L >1000	U 0.478 L NA	U 18.1 L NA	U 5(gph) L NA	NA	U 15 L <5

Notes:

bgs = below ground surface
gpm = gallons per hour
L = lower interval
NA = not applicable
NTU = nephelometric turbidity unit
U = upper interval

5.0 CIVIL SURVEY

The well locations were surveyed in accordance with GRP-EE-01-1.6 ("Survey Requirements and Techniques"). Vertical survey data were recorded using *North American Vertical Datum of 1988* (NAVD88) and the horizontal coordinates were recorded using the Washington State Plane (South Zone) *North American Datum of 1983* (NAD83), with the 1991 adjustment for horizontal coordinates. Surveyed locations of the boreholes are presented in Table 5-1 and the reports are located in Appendices A and B.

Table 5-1. Well Location Summary.

Well Name	Well ID	Washington State Ecology ID	Drilling Dates		Northing[a] (m)	Easting[a] (m)	Ground Surface Elevation[b] (Brass Cap) (m)	Total Depth (ft bgs)
			Start	Finish				
299-E27-155	C5852	ALF 975	9/26/06	11/13/07	136429.08	575003.11	207.680	340
699-52-55A	C5861	BAT 314	11/20/07	1/22/07	139443.2	573102.44	174.958	183.3

Notes:

[a] Northing and easting coordinates are based on Washington State Plane Coordinates *North American Datum of 1983* (NAD83) rounded to 1 m.

[b] *North American Vertical Datum of 1988* (NAVD88) values rounded to 0.001 m.

bgs = below ground surface.

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6.0 WASTE MANAGEMENT

Waste generated during drilling and construction of the two monitoring wells was managed using the strategy documented in the *Waste Control Plan for the 200-BP-5 Operable Unit* (DOE/RL-2003-30). Generated waste includes drill cuttings, purgewater, decontamination water, and miscellaneous solid waste. A data quality objective summary report (SGW-34748, *Data Quality Objectives Summary Report for the Installation of Wells C5852 and C5861 in the 200-BP-5 Operable Unit*) was prepared to define waste characterization requirements using historical analytical data and process knowledge.

6.1 VADOSE ZONE CUTTINGS

Drill cuttings (i.e., soils) from borehole C5852 were contained in 55-gallon drums starting at ground surface to a depth of 40 ft bgs due to the proximity of UPR-200-E-86 and soil contamination area 200-E-135. These cuttings were later transported to the Environmental Restoration Disposal Facility for disposal. Drill cuttings from 40 ft to 260 ft bgs were stockpiled on plastic sheeting and later spread near the well after well completion. All drill cuttings generated at borehole C5861 from above the historically high water table (165 ft bgs) were stockpiled on plastic sheeting near the point of generation. Since field radiological and chemical vapor surveying did not detect any contamination during the drilling operation, all drill cuttings were later spread on the ground near the well after well completion. Vadose zone cuttings were spread in accordance to GRP-EE-02-14.5 ("Returning Vadose Zone Drill Cuttings/Soils to the Environment").

6.2 SATURATED ZONE CUTTINGS

All saturated drill cuttings were contained in 55-gallon drums once the historically high water table was encountered. Free liquids from the contained saturated sediments were transferred, by pumping, to a purge water truck and managed as purgewater (Section 6.3). All saturated drill cuttings (after decanting) were transferred to the Environmental Restoration Disposal Facility for disposal.

6.3 PURGEWATER

Purgewater was generated during the drilling below the water table and during the well construction activities. All purgewater was contained on site in a purgewater truck and at the completion of the well construction activities, was transported to the Purgewater Storage and Treatment Facility.

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7.0 WELL ACCEPTANCE

Well acceptance is the final step in the well construction process and represents confirmation of meeting requirements of the work scope. Well acceptance also serves as the contractual completion of the finished product.

Representatives from the drilling contractor (Blue Star Enterprises North West), FH and Freestone Environmental Services, Inc. conducted a detailed walk down inspection of the well site and a review of the well drilling and completion documentation. The walk down inspection for wells C5852 and C5861 were conducted on November 15, 2007 and February 13, 2008, respectively. Final well acceptance was documented by completion of a checklist and signatures from representatives of the drilling contractor and FH. Surveillance QA-EQA-GRP-SURV-08-082 was issued documenting the acceptance of these two wells.

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8.0 REFERENCES

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, Public Law 96-150, 94 Stat. 2767, 42 USC 9601 et seq.

DOE/RL-2003-30, 2004, *Waste Control Plan for the 200-BP-5 Operable Unit*, Rev.2, U.S Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-55, 2006, *Sampling and Analysis Plan for FY 2006 200-BP-5 Groundwater Operable Unit Remedial Investigation/Feasibility Study*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2007-18, 2007, *Remedial Investigation/Feasibility Study Work Plan for the 200-BP-5 Groundwater Operable Unit, Hanford Site, Richland, Washington,* Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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GRP-EE-01-1.6, "Survey Requirements and Techniques"

GRP-EE-01-6.3, "Well Development and Testing"

GRP-EE-01-7.0, "Geologic Logging"

GRP-EE-02-14.1, "Drilling, Remediating, and Decommissioning Resource Protection Wells and Geotechnical Borings"

GRP-EE-02-14.5, "Returning Vadose Zone Drill Cuttings/Soils to the Environment"

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NAVD88, 1988, *North American Vertical Datum of 1988*, National Geodetic Survey, Federal Geodetic Control Committee, Silver Springs, Maryland.

RHO, 1978, *Geology of Gable Mountain – Gable Butte Area*, RHO-BWI-LD-5, Rockwell Hanford Operations, Richland, Washington.

RPP-23748, 2006, *Geology, Hydrogeology, Geochemistry, and Mineralogy Data Package for the Single-Shell Tank Waste Management Areas at the Hanford Site*, Rev. 0, CH2M Hill Hanford Group, Inc., Richland, Washington.

SGW-34422, 2007, *Description of Work for Calendar Year 2007 Installation of Two Groundwater Wells (299-E27-155, and 699-52-55A) at the 200-BP- 5 Operable Unit,* Rev. 0, Fluor Hanford, Inc., Richland, Washington.

SGW-34748, 2007, *Data Quality Objectives Summary Report for the Installation of Wells C5852 and C5861 in the 200-BP-5 Operable Unit*, Rev. 0, Fluor Hanford, Inc., Richland, Washington

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

APPENDIX A

WELL DOCUMENTATION FOR 299-E27-155 (C5852)

Borehole Log

Photographic Log

Well Summary Sheet

Well Construction Summary Report

Well Development and Testing Data

Well Survey

Sample Depths and HEIS #s

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BOREHOLE LOG

Page 1 of 9
Date: 9/26/07

Well ID: C5852
Well Name: 299-E27-155
Location: N of 7th St. S. of MO-527 near C-tank Farm
Project: 200-BP-5 RI/FS
Reference Measuring Point: Ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Drilling Sampling Tool, Sampler Size, Water Level
0				0-3' Fill	Cable tool, 8" Drive barrel, 10 3/4" casing
				3'-5' gravelly Sand (g S) 15% gvl 85% snd gvl: 50% basalt 50% qtz/others, CP-FP, rounded; Snd: C-VF, Predom M-VF, 70% qtz/others, 30% basalt, A, slightly moist, 2.5y 4/3 olive brown, str Rxn HCl	
5	grab			5'-Same lithology as above	1-pint archive samples collected at 5-ft intervals
10	grab			10'-Same lithology as above, slight ↑ in gravel %, 25% gvl 25% snd	
11	grab			11'-Sand (s) VC-VF, Predom C-M, 60% qtz/others 40% basalt, A, dry, 10YR 5/2 grayish brown, wk Rxn HCl	
15	grab			15'-Same lithology as above, Predom VC-C Snd	
20	grab			20'-Same lithology as above	
25	grab			25'-Sand (s) same lithology as above, slight ↓ in grain size	
30	grab			30'-Sand (s) same lithology as above, predom VC-C	
35	grab			35'-Same lithology as above	

Reported By: Jeff Fetters
Title: geologist
Signature: [signature] Date: 9/26/07

Reviewed By: L.D. Walker
Title: Geologist
Signature: [signature] Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 9
Date: 9/27/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: Hwy 7th St, S of MO-527 near C tank F.

Project: 200-BP-5 RI/FS | Reference Measuring Point:

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
40	grab			40': gravelly Sand(gS) 10% gvl 90% snd Snd: Same lithology as above; gvl: FP-CP, predom mP-FP, 60% qtz/others 40% basalt, SA-SR.	Cable Tool drilling 10 3/4" drill casing 8" drive barrel
45	grab			45' - Sand (S) 95% snd 5% gvl; gvl: VFP-mP basalt, SR-R; Snd: VC-VF predom M-C, 50% basalt, 50% qtz/ others, A, Dry, 2.5Y 4/2 dk gray; Sh brown, wk Rxn HCl	
50	grab			50' - Sand (S) Same lithology as above.	
55	grab			55' - Sand (S) Same lithology as above	6" drive barrel installed
60	grab			60' - Sand (S) Same lithology as above, increase in CS %, crc. med. pebble	
65	grab			65' - Sand (S) 5% gvl, 95% Snd; gvl: 50% basalt, 50% qtz/others, R-SA, wCP-VFP, Predom VF-FP, Snd: VC-VF Predom M-VF, A, 60% qtz/others, 40% basalt, Dry 10YR 5/1 gray, mod Rxn HCl	
69	grab			69' - gravelly Sand (gS) 20% gvl 80% Snd; gvl: SC-VFP predom M-FP, 60% qtz, 40% basalt, SR-R; Snd: VC-VF, Predom C-M, A, 60% qtz/others, 40% basalt, Dry, 10YR 5/1 gray, Wk Rxn HCl	69' - Cobbles up to 6cm
70	grab			70' - gravelly Sand (gS) Same as above	
75	grab			75' - Sand (S) 95% snd 5% gvl; gvl: 50% qtz, 50% basalt, R, VFP-MP, Predom VFP; Snd: VC-VF predom VC-M, 70% qtz/30% basalt, Dry, 10YR 5/1, gray, wk Rxn HCl, angular	

Reported By: Jeff Fetters | Reviewed By: L.D. Walker

Title: Geologist | Title: Geologist

Signature: [signature] Date: 10/1/07 | Signature: [signature] Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 9
Date: 10/1/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: 400' 7th St. S of M0527 near C tank Farm

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
80	grab			80' Sand (s) 80% snd 10% gvl 10% silt; gvl: 50% qtz, 50% basalt, R, VCP-VFP, Predom M-VFP; Snd: VF-VC predom M-VF, A, 70% qtz 30% basalt; Silt: Dry, 2.5y 6/1 gray wk Rxn HCl	Cable Tool / Drive barrel
85	grab			85' Sand (s) 95% snd 5% silt; Snd: VF-C, predom F-VF, 70% qtz 30% basalt, dry, 2.5y 4/1 gray, str Rxn HCl, A	
90	grab			90% Sand (s) F-C, predom F-M 70% qtz, 30% basalt, Dry, 2.5y 5/2 grayish brown, A	occ. large cobble
95	grab			95' Sand (s) F-M 75% qtz 25% basalt, moist, str rxn HCl, 10yR 4/3 brown, A	
100	grab			100' Sand (s) 100% snd, F-M 75% qtz 25% basalt, Dry, no Rxn HCl, 10yr 5/2, grayish brown, A	
105	grab			105'-Sand (s) Same lithology as above w/ med rxn HCl, increased Fine snd. %	
110	grab			110' Sand (s) Same lithology as above	
115	grab			115' Sand (s) 95% snd 5% gvl; gvl: VCP-MP, Predom CP, 60% qtz 40% basalt, R, Snd: VC-M predom C, 60% qtz, 40% basalt, dry 2.5y 5/2 grayish brown, wk Rxn HCl	118' ↑ Fine Sand %

Reported By: Jeff Fetters | Reviewed By: L.A. Walker

Title: geologist | Title: Geologist

Signature: [signature] Date: 10/1/07 | Signature: [signature] Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 9
Date: 10/4/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: 11 of 7th St, S of MO-527 near C tank Farm

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
120	grab			120' - Sand(s) 90% snd 10% gvl; gvl: VFP-VCP, Predom M-FP, basalt, A-SA; Snd: 60% qtz/others 40% basalt, VC-VF, Predom M-C, A, wk Rxn HCl, 10YR 4/2, Dk grayish brown, Dry	Cable tool / Drive barrel
123	grab			123' (GG) Sandy gravel, 40% gvl 60% snd; gvl: 8cm-3mm (SC-VFP), 50% basalt 50% qtz, R; Snd: VF-VC Predom VF-M, 70% qtz 30% basalt, mod Rxn HCl, 7.5YR 4/2 brown, Dry	123' Suspect larger cobbles
125	grab			125' gravelly Silty Sand (gmS) 30% silt 10% gvl 60% snd; gvl: 2cm-2mm (CP-VFP) predom M-FP, basalt 50% 50% qtz, R; Snd: M-VF, Predom M-F, A, 70% qtz 30% basalt; Silt Dry 7.5YR 5/2 brown, Str Rxn HCl	127' Increased gravels
129	grab			129' Sand(s) VC-VF predom C-M, 70% qtz 30% basalt, A, Dry 10YR 4/2, Dk grayish brown Wwk Rxn HCl	
130	grab			130' Same lithology as above w/ ↑ Fines, Mod Rxn HCl	
135	grab			135' - Sand (s) Same lithology as above	
140	grab			140' - Sand (s) Same lithology as above, Predom. M-F, mod Rxn HCl	
144				144 - Silty Sand (mS) 70% Snd 30% Silt; Snd: VC-VF predom. F-VF, 90% qtz 10% basalt, A-SA; Silt: Dry, Str Rxn HCl, 10YR 6/2, lt. brownish gray	
150	grab			150' - Silty Sand (mS) 70% snd 30% Silt; Snd: Same lithology as above; Silt: Dry 10YR 5/2 grayish brown, wstR Rxn HCl	
153	grab			153' - Sand (s) VC-VF predom C-M, 80% qtz, 20% basalt, A, Dry 10YR 4/2, Dk grayish brown, wwk Rxn HCl	153' - occ. pebble (MP-VFP)
155	grab			155' - Sand (s) Same lithology as above	

Reported By: Jeff Fellers | Reviewed By: L. D. Walker

Title: Geologist | Title: Geologist

Signature: [signature] Date: 10/4/07 | Signature: [signature] Date: 12/10/07

A-6003-842 (03/03)

BOREHOLE LOG

Page 5 of 9
Date: 10/8/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: N of 7th ST. S. of MO-527 Near C Farm
Project: 100-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
160	grab			160'- Sand (s) Same lithology as above, Mod Rxn HCl, ↑ Mica %	Cable Tool, Drive barrel
				163' Silty Sand (s) 60% sand 40% silt; Sand: VC-VF Predom M-VF, A, 80% qtz 20% basalt; Silt: Str rxn HCl, Dry, 10YR 5/2 grayish brown	
163	grab			164' Sand (s) VC-VF predom M-L 80% qtz 20% basalt, wk Rxn HCl, A, Dry, 7.5YR 5/2 brown	
165	grab				
170	grab			170' Sand (s) Same lithology as above, increase in Fine Sand Content	
					173' ↑ Fine Sand content
175	grab			175' Sand (s); Predom F-M, 7.5YR 5/2 brown, wk Rxn HCl, A, Dry, 90% qtz 10% basalt	
180	grab			180' Sand (s) Same lithology as above	180' Drillers add 2 gal H_2O, Cuttings falling from DB
185	grab			185' gravelly Sand (gS) 70% sand 30% gvl; gvl: 60% basalt 40% qtz/other, A, VFP-LC predom VFP-FP; Sand: VC-F, predom VC-C, A, 70% qtz 30% basalt, Slightly moist, 10YR 4/2, Dk grayish brown, vwk Rxn HCl	
187	grab			187' Sand (s) Predom M-F, 90% qtz 10% basalt A, wk Rxn HCl, Dry 7.5Y 4/2 brown, wk Rxn HCl	
190	grab			190' gravelly Sand (gS) 70% sand 30% gvl; gvl: 80% basalt 20% qtz, A-SA, VFP-CP, Predom FP; Sand: VC-F predom VC-C, wk Rxn HCl, Slightly moist, 7.5YR 4/2 brown	
193	grab			193' Sand (s) M-F, 90% qtz 10% basalt, A, wk Rxn HCl, Dry 7.5Y 4/2 brown	
195	grab			195' Sand (s) VC-F, Predom C, A, 70% qtz 30% basalt, Dry, 7.5YR 5/2 brown vwk Rxn HCl	

Reported By: JEFF FEHERS | Reviewed By: L.J. Walker
Title: geologist | Title: Geologist
Signature: [signature] | Date: 10/9/07 | Signature: [signature] | Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 6 of 9
Date: 10/9/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: N of 7th St, S of Mo527 Near C Farm

Project: 200-BP-5 RI/FS | Reference Measuring Point: Ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
200	grab			200'-Sand (s) Predom m-F, 70% qtz 30% basalt, A, Dry, 7.5Y 4/2 brown, mod Rxn HCl	Cable Tool 8" casing Drive barrel
205	grab			205'-Sand (s) 90% qtz/others, 10% basalt, C-F, Predom M-F, A, Dry, 7.5Y 5/2, brown, Mod. Rxn HCl	205' 2.5 gal H_2O added after grab sample collected to aid in cuttings removal
210	grab			210' Sand (s) 90% qtz/other 10% basalt, Predom M-F, Slightly moist 5YR 5/2 reddish gray, wk Rxn HCl	210, moisture due to water added
215	grab			215' Sand (s) Same lithology as above, 7.5YR 4/3, brown	
220	grab			219'-Silty Sand (mS) 60% Snd 40% Silt; Snd: Predom M-VF, A, 90% qtz 10% basalt; Silt: Dry, 10YR 5/2 grayish brown, mod rxn HCl	
225	grab			223' Sand (s) 90% qtz 10% basalt M-VF, A, Dry 10YR 5/2 grayish brown, wk Rxn HCl	
				225' Same lithology as above	228' occ. med. pebble
230	grab			230' gravelly Sand (gS) 90% snd 10% gvl gvl: 70% basalt 30% qtz, MP-FP, Predom FP, A; Snd 70% qtz 30% basalt, VC-VF, Predom C M, A, Dry, 10YR 5/2, wk Rxn HCl	233' ↑ gvl up to 6cm
				234' gvl to 30% snd to 70%	235' Driller having trouble removing DB from bore hole, gvl to 15cm, DB ↓
235	grab			237'-Sand (s) 90% snd 10% silt; Snd: 60% qtz 40% basalt, A-SA, C-VF; Silt, moist, 2.5Y 4/2 Dk grayish brown, wk Rxn HCl	
237	grab			239' Sand (s) C-VF (Predom F-M) 80% qtz 20% basalt, Dry, 2.5Y 5/2 grayish brown, wk Rxn HCl	237' moisture due to H_2O added
239	grab				

Reported By: Jeff Fellers | Reviewed By: L. D. Walker

Title: geologist | Title: Geologist

Signature: [signature] | Date: 10/9/07 | Signature: [signature] | Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 9
Date: 10/10/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: N of 7th St S of NO-527 Near C Farm

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
242	grab			240' Sand (s) Same lithology as above	Cable Tool / Drive barrel
243	grab			243' Sand (s) M-F, 80% qtz/others 20% basalt, A-SA, slightly Moist, 10YR 3/4 brown,	243'- high mica content, borehole caving in
245	grab			wk Rxn HCl	
				245'- Silty Sand (mS) 70% sand 30% Silt; sand M-VF Predom F-VF, 90% qtz/others 10% basalt	
				SA-A; Silt: Dry, 10YR 6/2, H. brownish gray, str rxn HCl, slight compaction	
250	grab			250'- Sand (s) 90% qtz/others 10% basalt, A-SA, Dry 7.5YR 5/3 brown, wk Rxn HCl, M-F grain	250' grab Sample (G/S) ~~# BIPMY8~~ BIPMY9
252.5	grab			252.5'- Same lithology as above	252.5' (G/S) # BIPN00
255	grab			255'- Sand (s) 80% qtz/other 20% basalt, F-M SR-SA, Mod Rxn HCl, Dry, 10YR 5/3 Brown	255' (G/S) # BIPN01
257.5	grab			257.5' Same lithology as above	257.5' G/S # BIPN02
258	grab			258' gravelly sand (gS) 20% gvl 80% sand; gvl: 60% basalt 40% qtz, R, 6cm-2mm (vcP-vfP)	
260	grab			Predom MP; Sand: Same lithology as above	260' G/S # BIPN03
				260'- gravelly Sand (gS) gvl 20%, sand 80%; gvl:	
262.5	grab			Same lithology as above; Sand: VC-VF Predom M-F, 60% qtz 40% basalt, wk Rxn HCl, Dry, 7.5	262.5' G/S # BIPN04
					262.5' Drill Rate ↓
265	grab			YR 5/2, brown	265' G/S # BIPN05
				263'- Silty gravel (mG) 40% gvl 40% Silt 20% sand	
267.5	grab			gvl: 5cm-2cm (vcP-vfP), 60% basalt 40% qtz, R; sand: C-VF Predom VF-F, 60% basalt 40% qtz, A; Silt,	267.5' G/S # ~~BIPN05~~ BIPN06
				Dry, 10YR 6/2 H brownish gray, Mod Rxn HCl	increasing Sand. %
270	grab			270'- gravelly sand (gS) 60% gvl 40% sand; gvl:	270' G/S # ~~BIPN06~~ BIPN07
271		3/5 Blows: 12ft 72% Rec		50% qtz 50% basalt, 6cm-2cm (vcP-vfP), R-SR; sand: VC-VF Predom F-VF, 90% qtz 10% basalt, A-SA, Dry	
				10YR 5/3, brown, wk Rxn HCl	271-273.5 S/S #
273.5	grab	5/5 Blows: 15ft 85% Rec		273.5'- Same lithology as above	273.5' G/S # BIPN08
275	grab			275'- Silty Gravel (mG) 50% gvl 40% Silt, 10% sand	275 G/S # ~~BIPN08~~ BIPN09
276				gvl: 4cm-2cm (vcP-vfP) Predom MP, R, 60% basalt, 40% qtz/other; Sand: VC-VF Predom F-VF, 60% basalt	273.5-276' S/S #
					276' casing Driving Hard
277.5	grab			40% qtz, A-SA,: Silt: Dry, 10YR 5/2, grayish brown, wk Rxn HCl	277.5' G/S # ~~BIPN09~~ BIPN10

Reported By: Jeff Fehos | Reviewed By: C.D. Walker

Title: geologist | Title: Geologist

Signature: [signature] | Date: 10/15/07 | Signature: [signature] | Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 8 of 9
Date: 10/15/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: NOF 7th St, S of MO-527 Near C Farm

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
280	grab	S/S 100% Rec.		280'-Sandy Gravel (SG) 50% snd, 45% gvl, 5% silt; gvl: 70% basalt 30% qzt, SA, SR, 6cm-3cm; Snd: F-C 25% basalt 25% qzt, 10YR 5/2, DK grayish brown, moist, no Rxn HCl	Cable Tool / Drive barrel 280' G/S # BIPN10 collected at 279.5' bgs BIPN11 Sample Depths Redone 284.5' G/S # BIRQY7
285	grab	S/S 100% Rec.		285'-Gravel (G) 90% gvl 10% snd; gvl: 4cm-2mm (VCP-VFP), Predom MR, 70% basalt 30% qzt, R-SR; Snd: VC-VF predom VC, 70% basalt 30% qzt/other, Wet, 10YR 4/1 DK gray, no Rxn HCl, A	284.5-287 S/S 287' G/S # BIRQY8, collected at 286.5' bgs
290	grab	S/S Blows: 50 Rec. 75%		290' same lithology as above w/snd to 20%	278-289.5 S/S 289.5' G/S # BIRQY9
292	grab water sample	S/S Blows: 50 Rec. 70%		292' lithology same as above, gvl to 7cm, suspect larger	292' water sample, no open hole 292' G/S # BIR100 292-294.5' S/S # BIR101
295	grab			295' lithology same as above, w/ gvl 50% basalt 50% qzt	295' G/S # BIPN12 296' loose Formation, DB driving Casing
	grab			297' lithology same as above	297' G/S # BIPN13
300	grab			300' Sandy Gravel (SG) 80% gvl 20% snd: Gvl: 6cm-2mm (VCP-VFP) predom MR, 60% basalt 40% qzt, R; Snd: VC-VF Predom C, 70% basalt 30% qzt, No Rxn HCl, Wet, 10YR 4/1 Dk gray	300' G/S # BIPN14 300' increased mica %
302	grab	S/S Blows: 91 Rec: 100%		302' Sand (S) 60% basalt 40% qzt, VC-M, Predom VC, A, Wet, No Rxn HCl, 10YR 3/2, VDK grayish brown	302' G/S # BIPN15 302.2'-304.7' S/S # 304.9-307.4' S/S
305	grab	S/S Blows: 1-Rec: 100%		305'-Sandy Gravel (SG) 80% gvl 20% snd: Gvl: 60% basalt 40% qzt, 6cm-2mm (VCP-VFP) R-SR; Snd: 60% basalt 40% qzt, A, VC-VF Predom VC-C, Wet, 10YR 3/2 DK grayish brown no Rxn HCl	305' G/S # BIPN16 306.5' G/S # BIPN17 307.5' Ground water Sample, no open hole
310	grab			310' Sandy Gravel (SG), lithology same as above, gvl: to 50% snd to 50% predom MR; Snd: 70% basalt 30% qzt, A-SR, Predom C-VC, trace of Silt (<5%)	310.5' G/S # BIPN18 311.4' G/S # BIPN19 311.4-319.9' S/S # BIPN18
315	grab			315' Sandy Gravel (SG) 80% gvl 20% snd: Gvl: 6cm-2mm (VCP-VFP) (suspect larger) 70% basalt 30% qzt, R; Snd: VC-VF Predom C-VC 60% basalt 40% qzt, A, Wet, No Rxn HCl, 10YR 3/1 VDK gray	315' G/S # BIPN20 317.5' G/S # BIPN21 319.5' G/S # BIPN22
320	grab				

Reported By: Jeff Fethers | Reviewed By: L. J. Walker

Title: Geologist | Title: Geologist

Signature: [signature] Date: 10/19/07 | Signature: [signature] Date: 12/10/07

A-6003-642 (03/03)

BOREHOLE LOG

Page 9 of 9
Date: 10/22/07

Well ID: C5852 | Well Name: 299-E27-155 | Location: Hole 7 St, S of Mo 522 near C-Farm

Project: 200-BP-5 R/B | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
320	grab				Cable Tool / Drive barrel
	grab			320' sandy Gravel (SG) - lithology	319.5' g/s # B1PN22
				Same as above, gvl predom CR-MP	322' G/s # B1PN23
322	grab	5/5 Blows: 85 Rec: 100%			322-324.5' s/s
					324.2' G/s # B1PN24
325	grab	5/5 Rec: 100%		325' Gravel (G) 80% gvl 10% snd 10% silt	324.2-326.8 s/s # B1PN26
	grab			gvl: lithology same as above; Snd: same	
327	grab water sample			as above; silt wet 10YR 3/2 VDK grayish	327' G/s # B1PN25
327.5				brown, no Rxn HCl	327.5' water sample,
					casing driving hard
330	grab			330' Gravel (G) 85% gvl, 15% snd, 5% silt	330' G/s # B1PN20
				gvl: 60% basalt 40% sed, 2cm-2mm (SC-VFP).	
332	grab water sample	5/5 Blows: 49 Rec: 100%		Predom CP, R; Snd: VC-M, 60% basalt, 40% sed,	332' G/s # B1PN27
				A, Predom VC; silt wet 10YR 3/2, VDK grayish	332-334.5 s/s # B1PN27
				brown, no Rxn HCl	334.5' smaller diameter OB
335	grab				334.5' G/s # B1PN28
	grab	4 Rec: 80%		332' Silty Gravel (MG) 70% gvl 10% snd	335-336' s/s
336				20% silt; gvl: 50% basalt 50% sed, R, 12cm-	335' Dust from Drive barrel
				2mm (LC-VFP); Snd: VF-VC, Predom M, 80% sed	cuttings recovered from possible
				20% basalt, A; Silt: wet, 10YR 3/3 Dk Brown,	crushed rock
340				wk Rxn HCl, Strong cementation	332-340', Groundwater
				335' Gravelly silt (GM) 70% silt 30% gvl;	Sample
				gvl: 60% basalt 40% sed/other, Sp-MP, A-SR;	
				Silt: wet, no Rxn HCl, 10YR 3/1, VDK gray,	
				Mottling 10YR 3/6 Dk yellowish brown	
345				336' Basalt, Elephant Mountain	
				Basalt	

Reported By: Jeff Fetters | Reviewed By: L.D. Walker

Title: geologist | Title: Geologist

Signature: Jeff Fetters | Date: 10/24/07 | Signature: [signature] | Date: 12/10/07

A-6003-642 (03/03)

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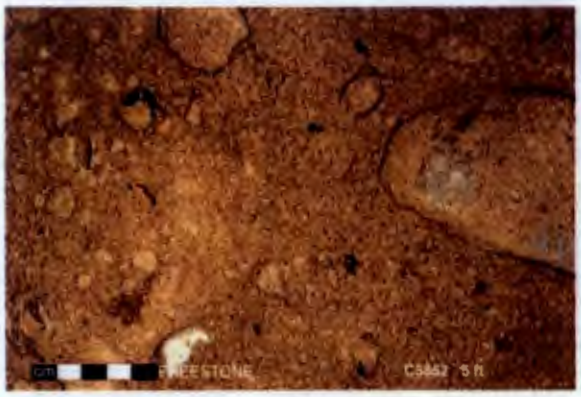

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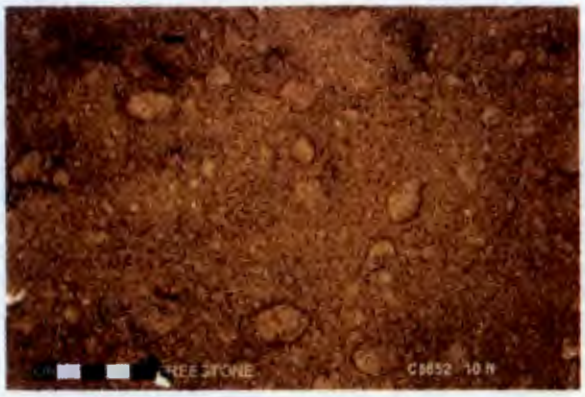

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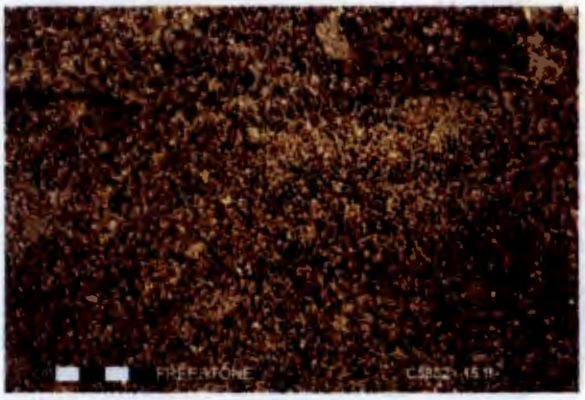

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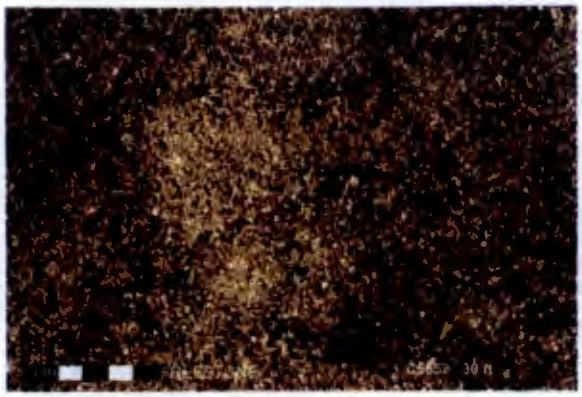

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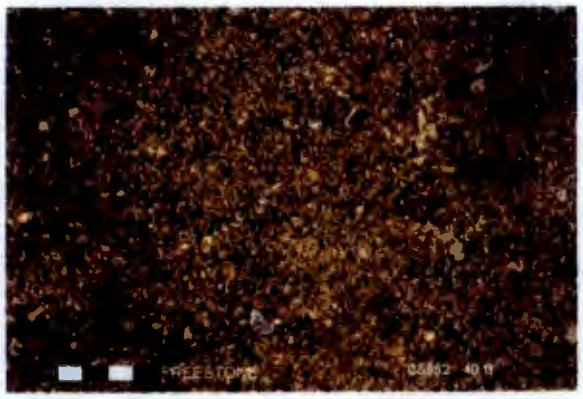

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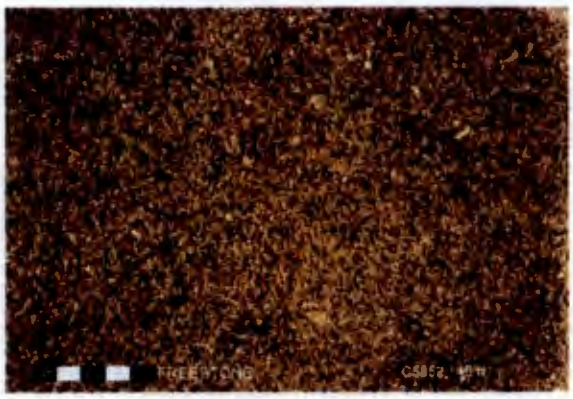

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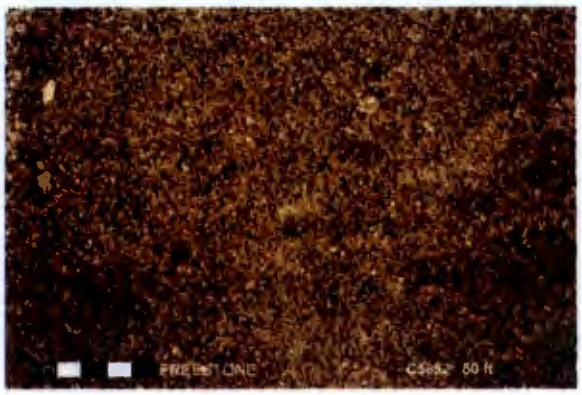

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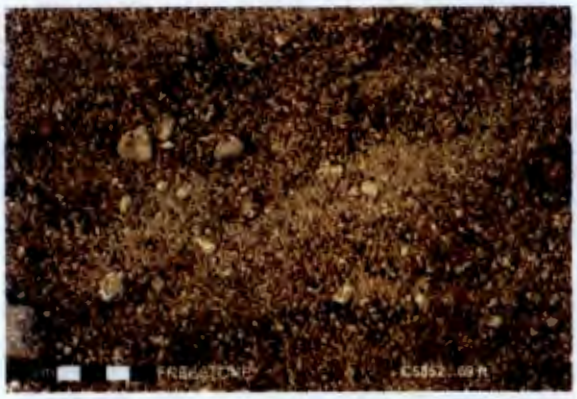

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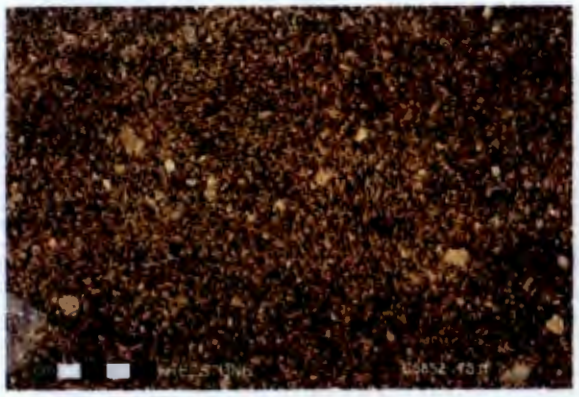

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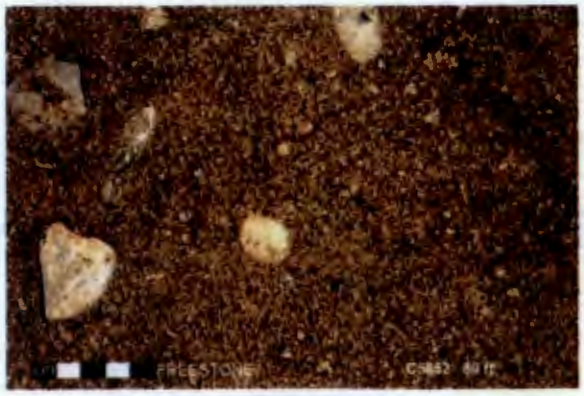

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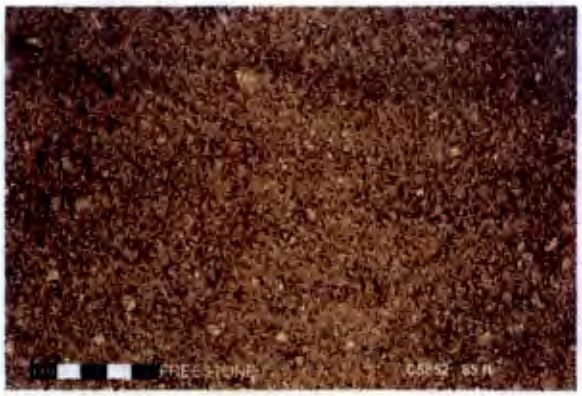

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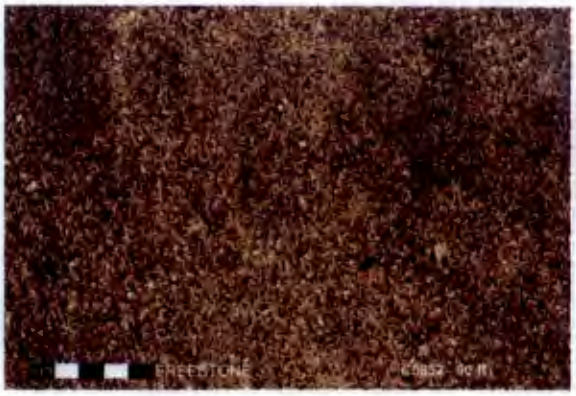

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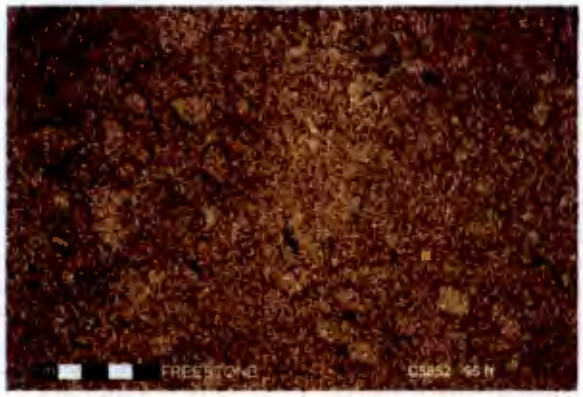

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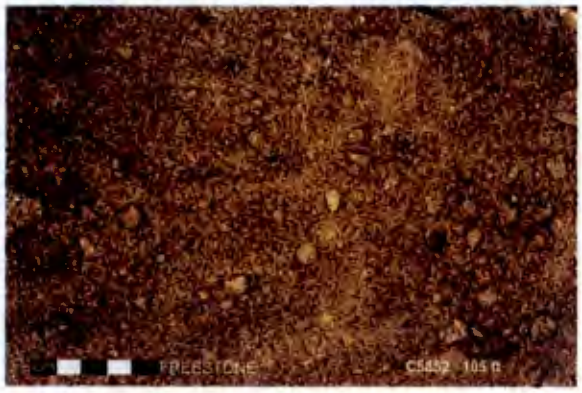

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Well C5852

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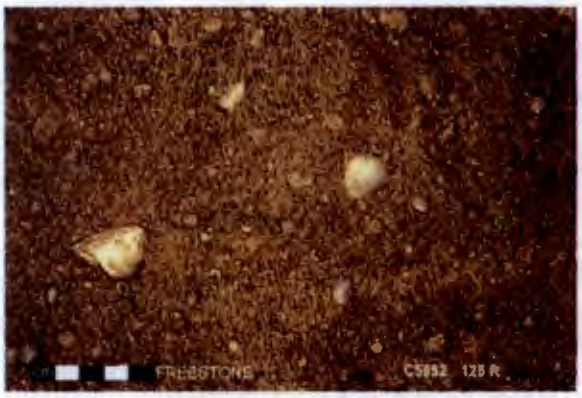

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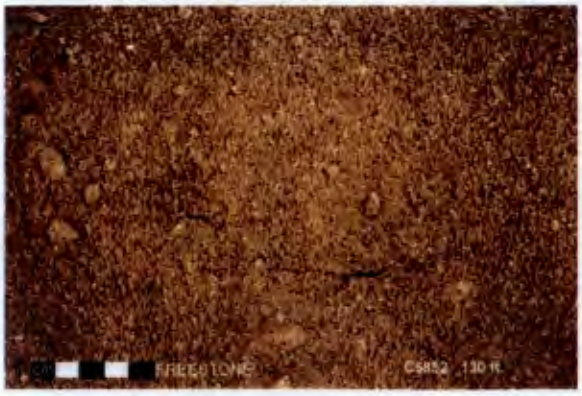

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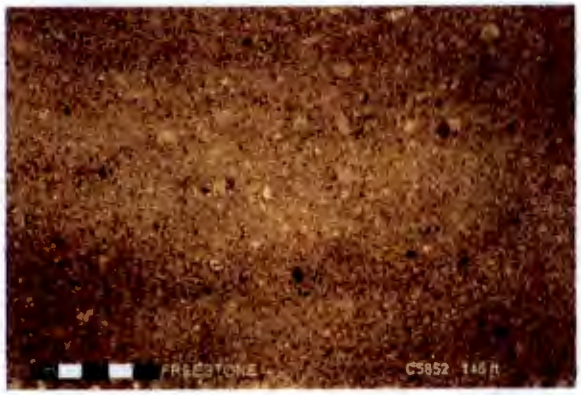

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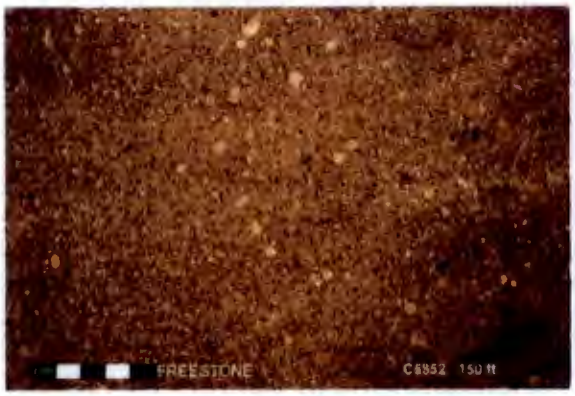

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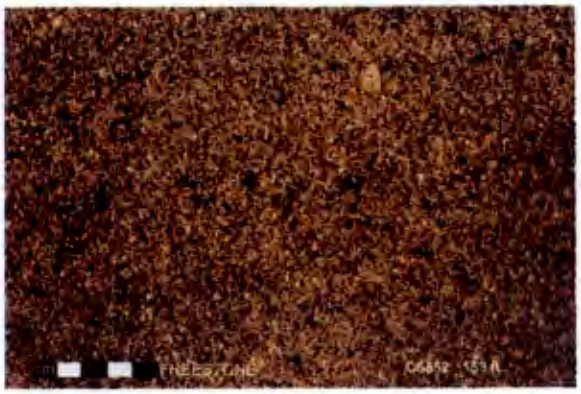

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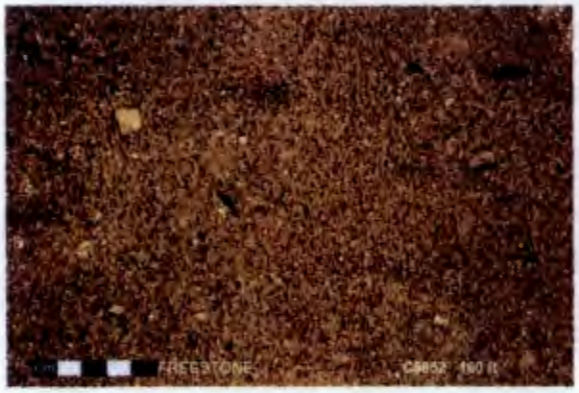

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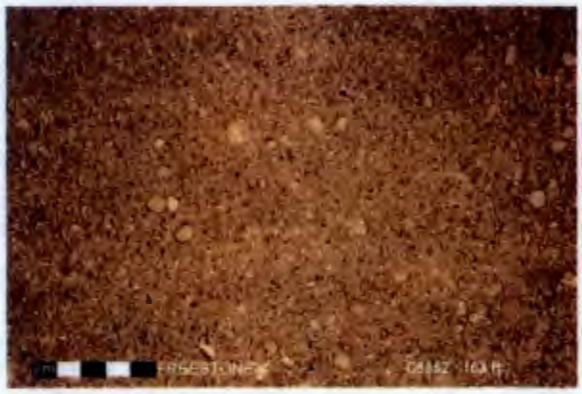

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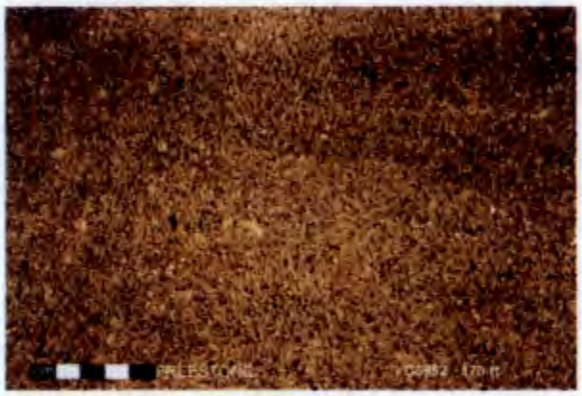

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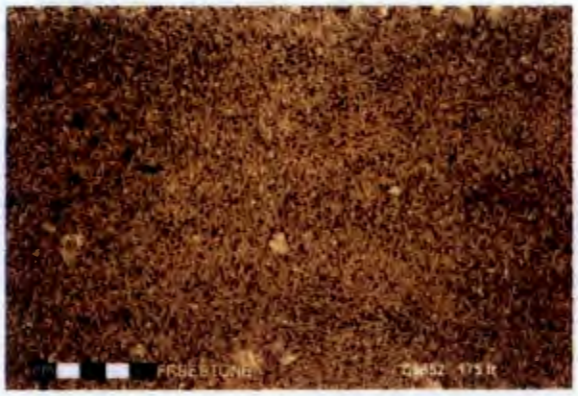

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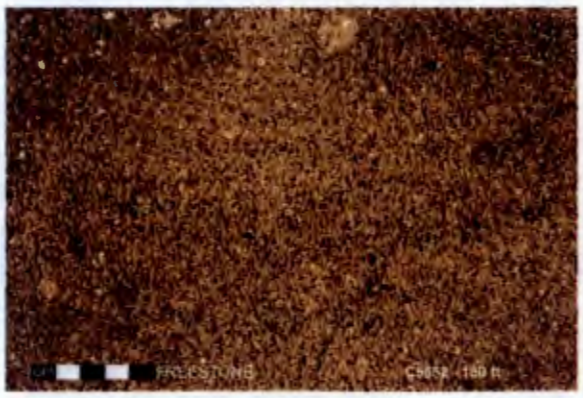

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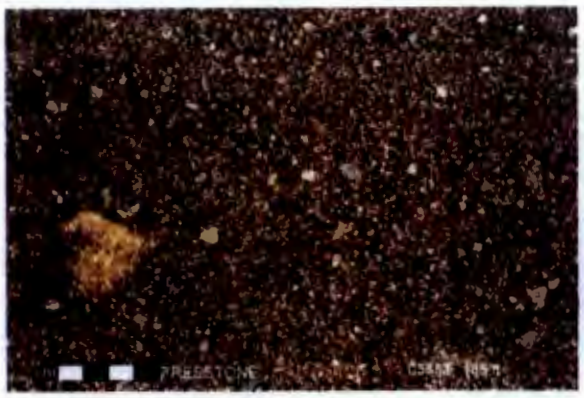

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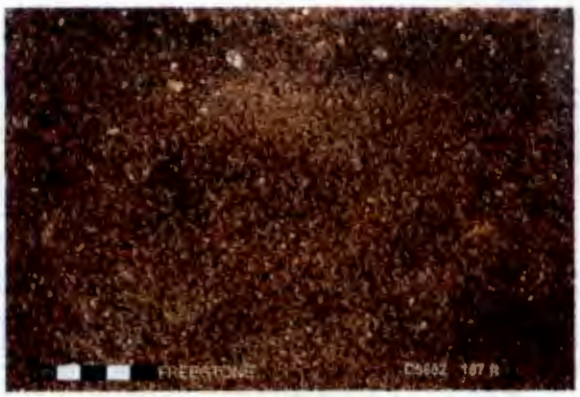

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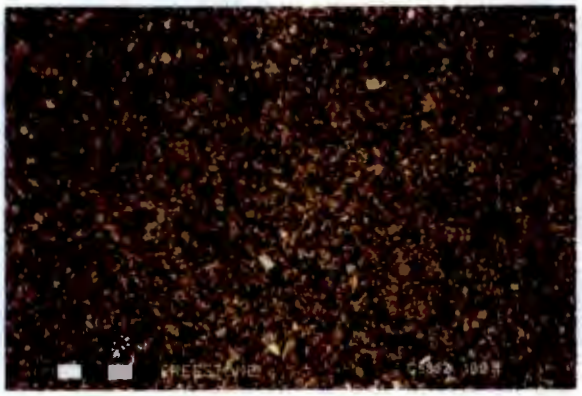

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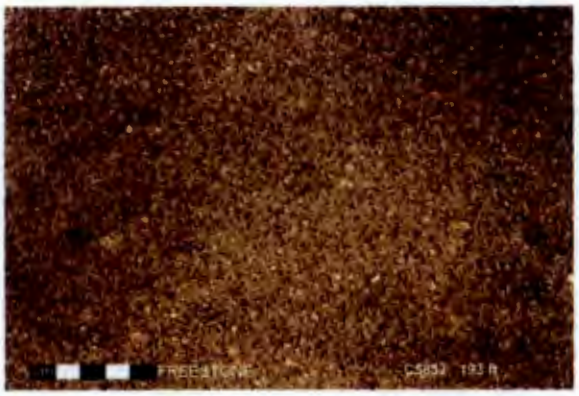

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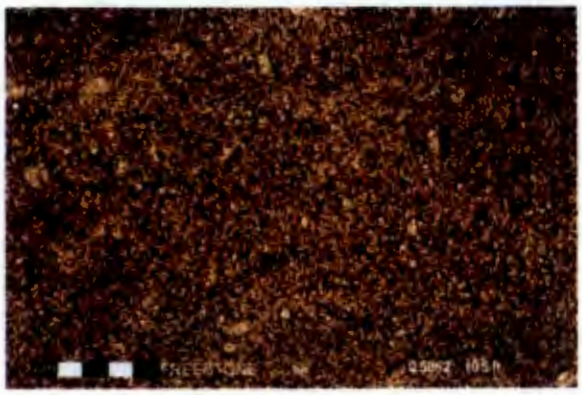

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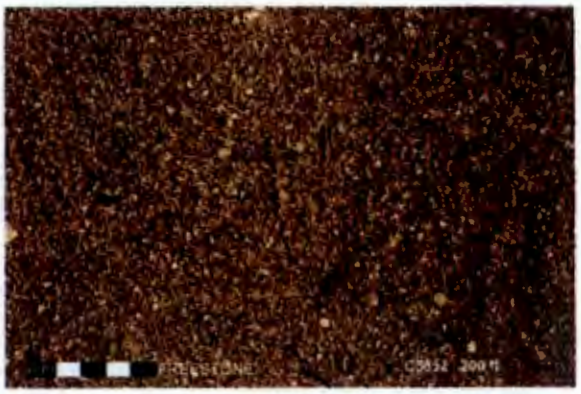

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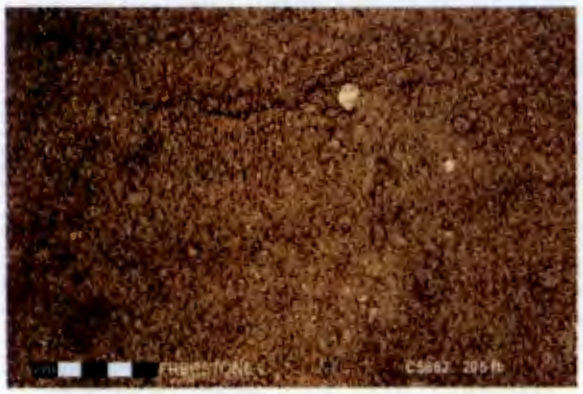
Well C5852



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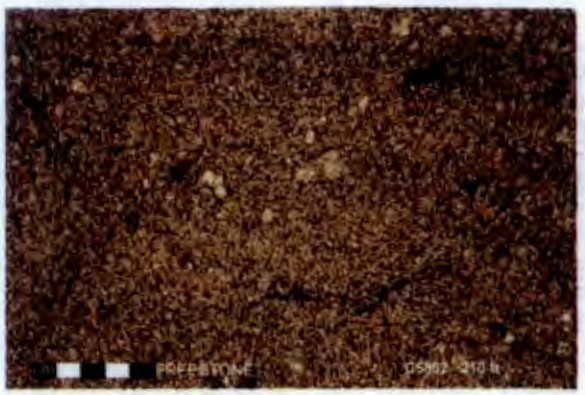

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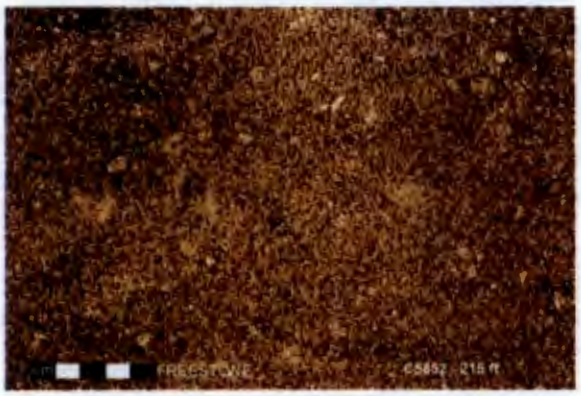

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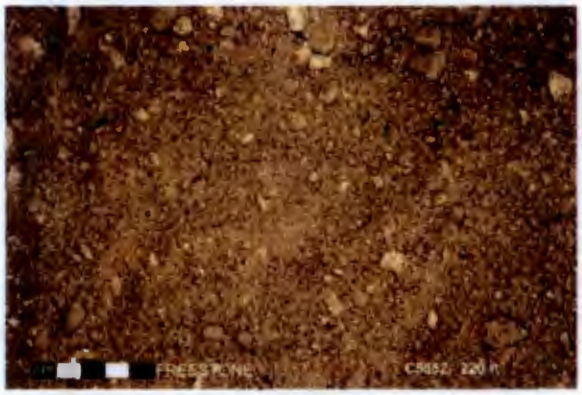

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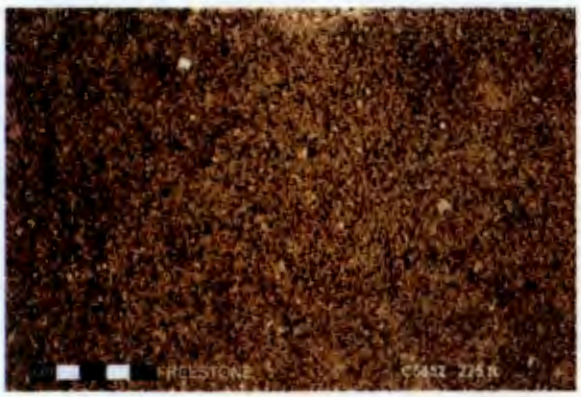

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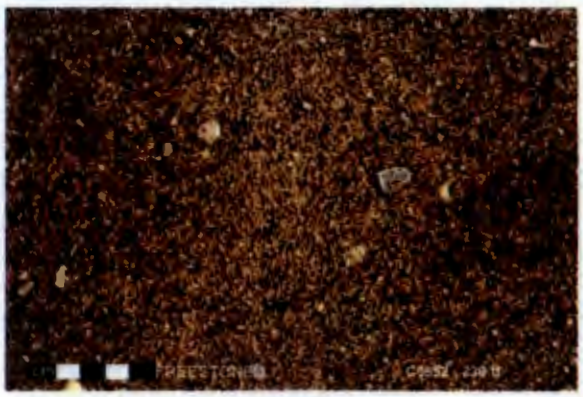

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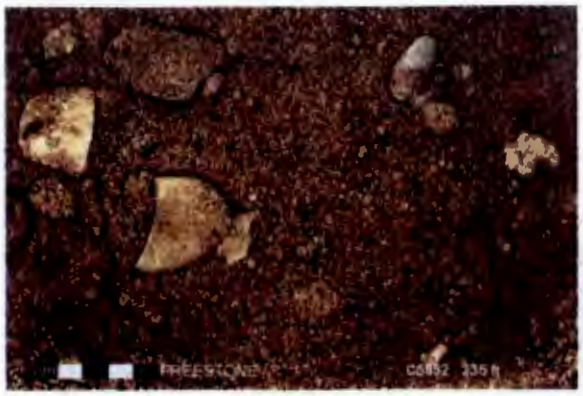

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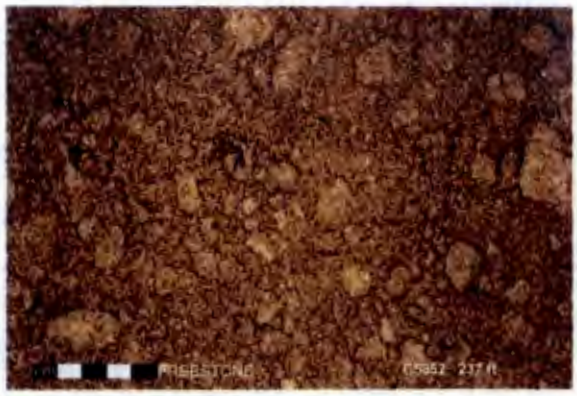

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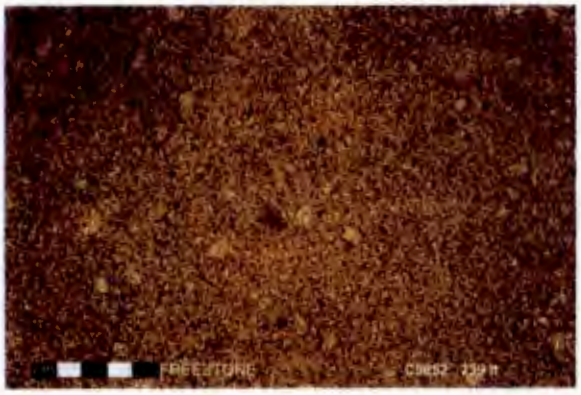

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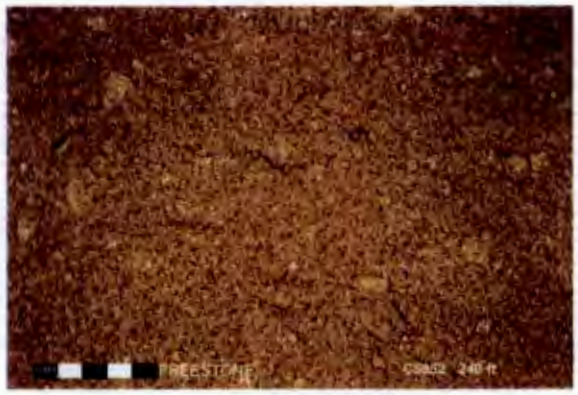

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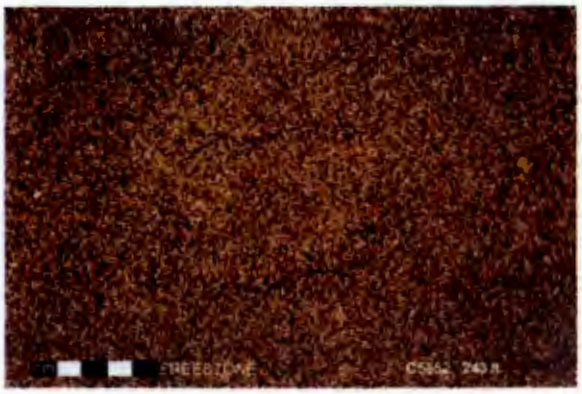

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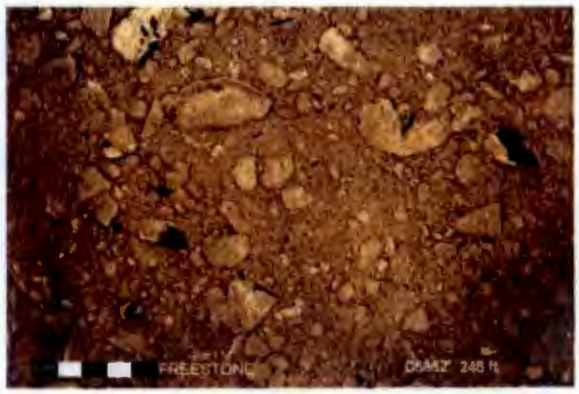

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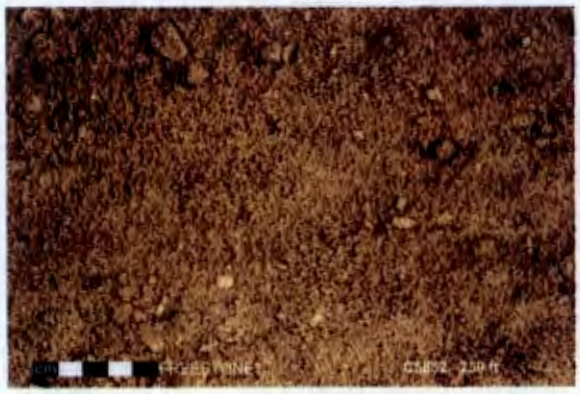

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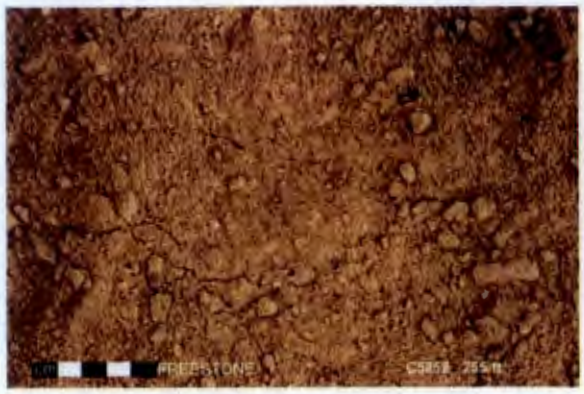

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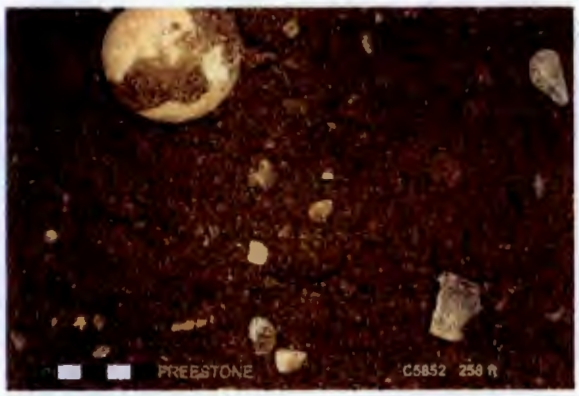

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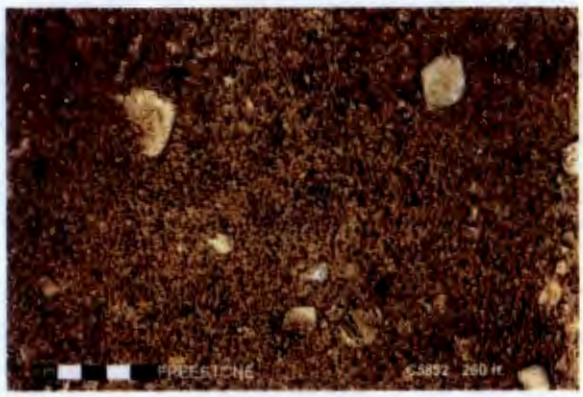

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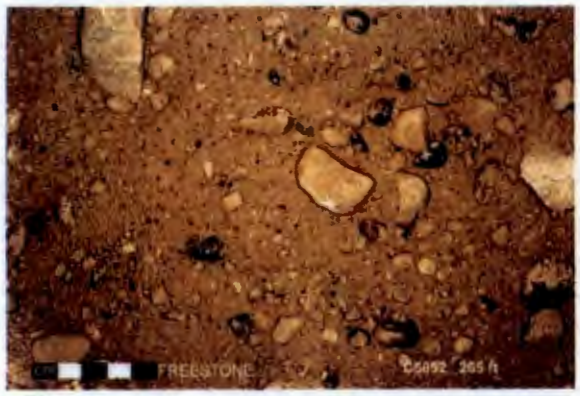

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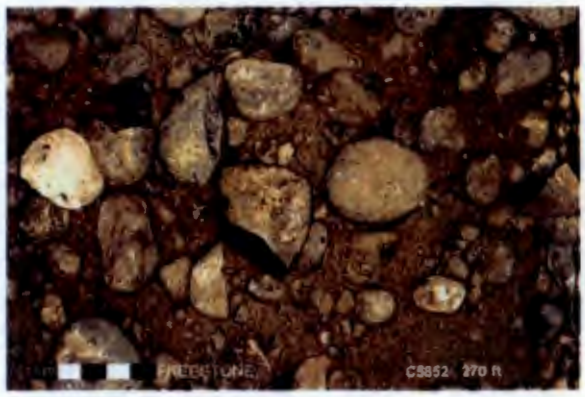
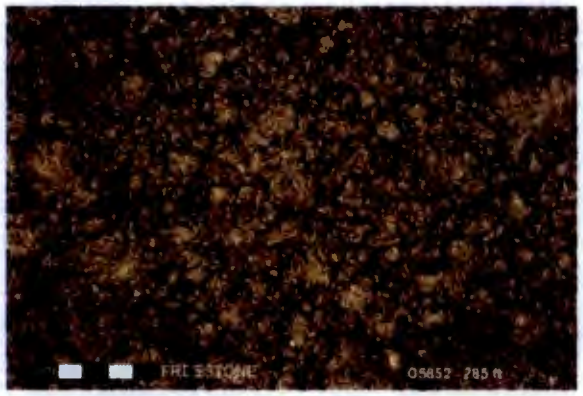


270 ft

Well C5852

275 ft

280 ft



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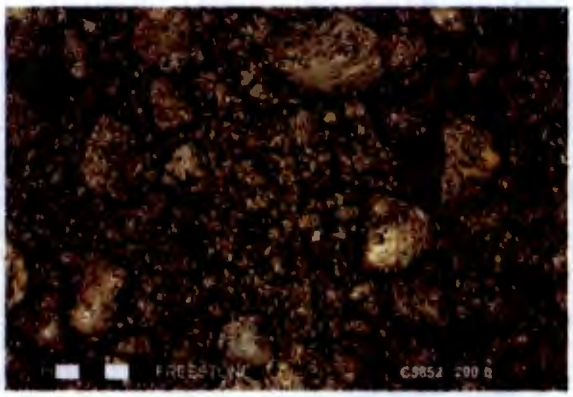

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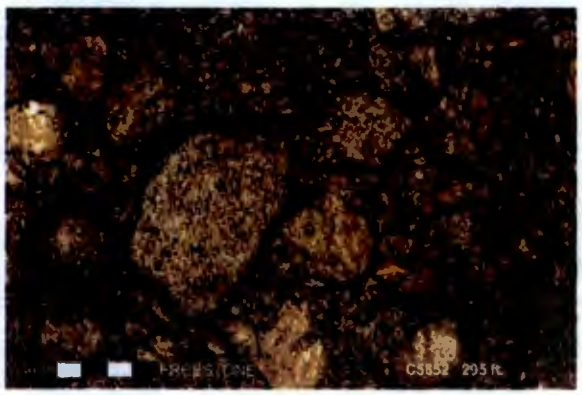

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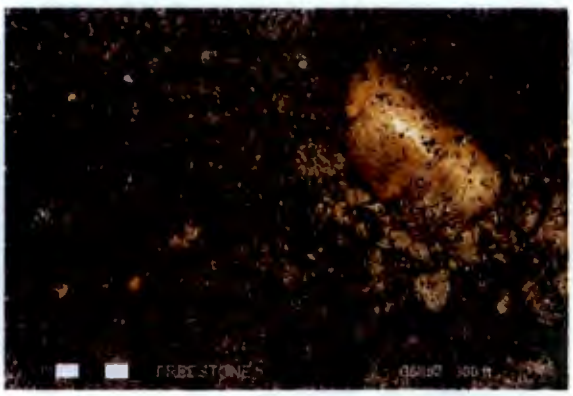
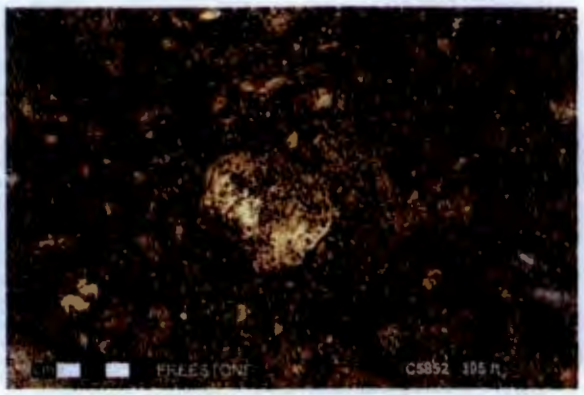


300 ft

Well C5852

302 ft



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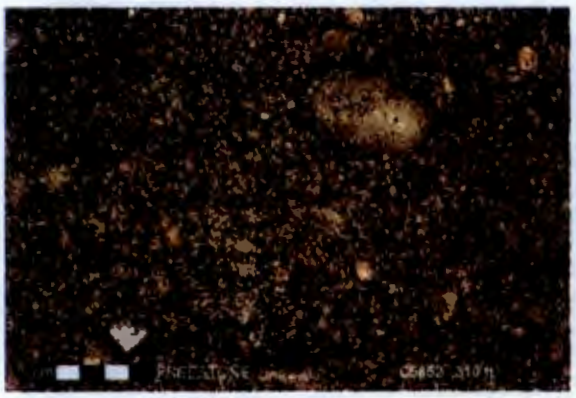

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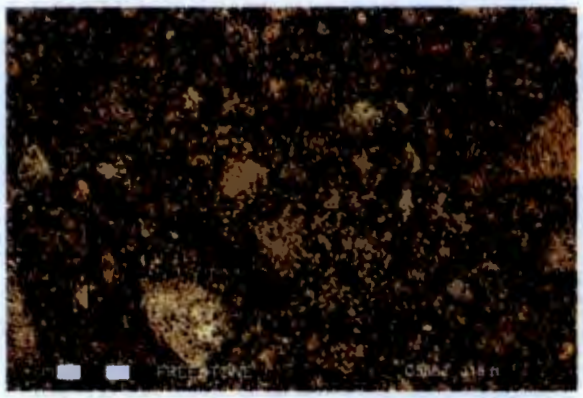

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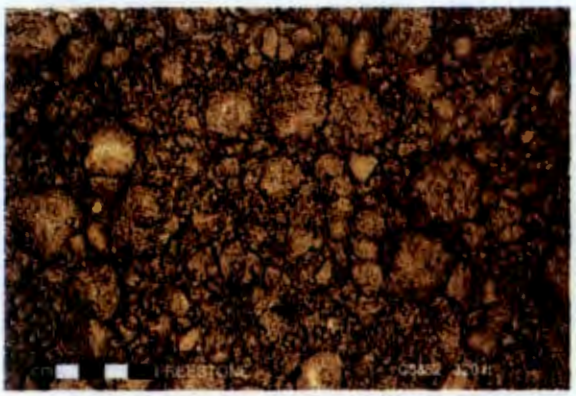

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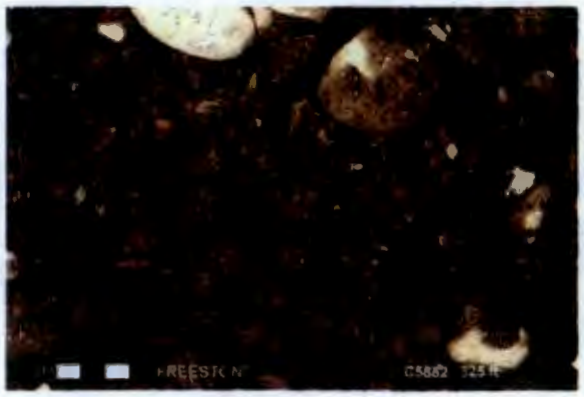

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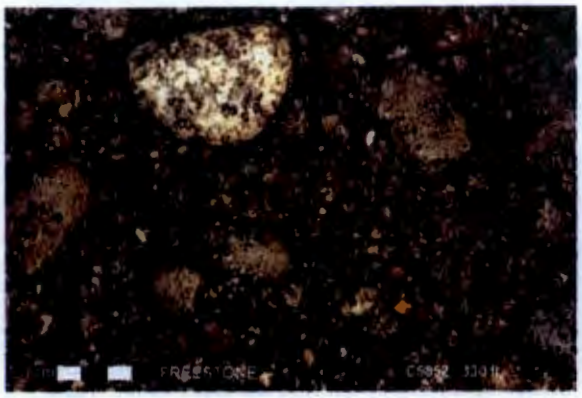
Well C5852



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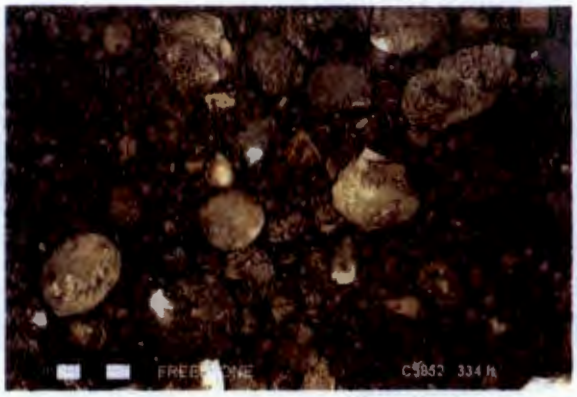

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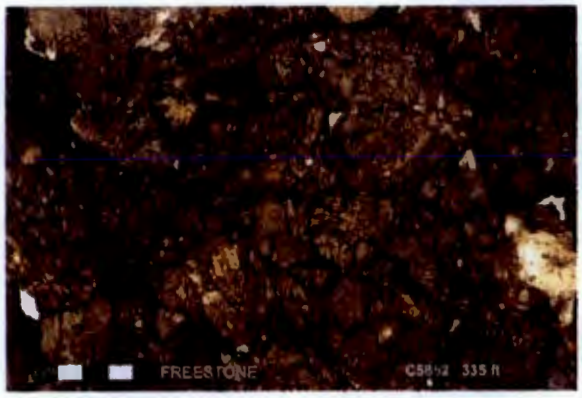

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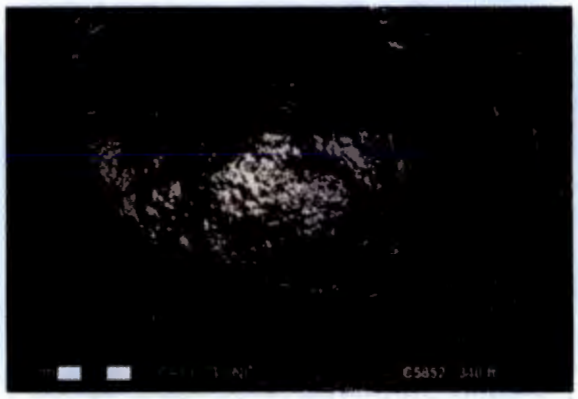


340 ft

WELL SUMMARY SHEET	Start Date: 09/26/06 Finish Date: 11/13/07	Page 1 of 4
Well ID: C5852	Well Name: 299-E27-155	
Location: N. of 7th St., S. of MO-527 near C-Tank Farm	Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters — Date: 11/15/07	Reviewed By: L. D. Walker — Date: 12/10/07	
Signature: JW Fetters	Signature: LD Walker	

CONSTRUCTION DATA

Description	Diagram
6-in Concrete Pad 6-in I.D. Type 304/304L Stainless Steel Protective Casing: +2.72 ft above Ground Surface Portland Cement Type I/II: 0 - 10.01 ft Granular Bentonite Crumbles: 10.01 - 279.0 ft 4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft All depths are in feet below ground surface. Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-3 Sandy Gravel sG (Fill)
		3-11 Gravelly sand gS
10		11-40 sand S
20		
30		
40		40-45 Gravelly Sandy gS
		45-69 Sand S
50		
60		
70		69-75 Gravelly Sandy gS
		75-123 Sand S
80		

WELL SUMMARY SHEET	Start Date: 09/26/07 Finish Date: 11/13/07	Page 2 of 4

Well ID: C5852		Well Name: 299-E27-155	
Location: N. of 7th St.. S. of MO-527 C-Tank Farm		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters	Date: 11/15/07	Reviewed By: L. D. Walker	Date: 12-10-07
Signature:		Signature:	

CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
All depths are in feet below ground surface.	
Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
90		75-123 Sand S
100		
110		
120		123-125 Gravelly Sandy gS 125-129 Gravelly Silty Sandy gmS
130		129-144 Sandy S
140		144-153 Silty Sand mS
150		153-163 Sand S
160		163-164 Silty Sand mS 164-185 Sand S
170		

WELL SUMMARY SHEET	Start Date: 09/26/07 Finish Date: 11/13/07	Page 3 of 4
Well ID: C5852	Well Name: 299-E27-155	
Location: N. of 7th St., S. of Mo-527 near C-Tank Farm	Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters — Date: 11/15/07	Reviewed By: L.D. Walker — Date: 12/6/07	
Signature: Jeff Fetters	Signature: L.D. Walker	

CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
All depths are in feet below ground surface.	
Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft	
All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
180		
		185-187 Gravelly Sandy gS
		187-190 Sand S
		190-193 Gravelly Sand gS
190		
		193-219 Sand S
200		
210		
		219-223 Silty Sand mS
220		
		223-230 Sand S
		230-237 Gravelly Sand gS
230		
		237-258 Sand S
240		
250		
		258-263 Gravelly Sand gS
260		
		263-270 Silty Gravel mG

WELL SUMMARY SHEET	Start Date: 09/26/07 Finish Date: 11/13/07	Page 4 of 4

Well ID: C5852		Well Name: 299-E27-155	
Location: N. of 7th St., S. of Mo-527 near C-Tank Farm		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters	Date: 11/15/07	Reviewed By: L. D. Walker	Date: 12/10/07
Signature: Jeff Fetters		Signature: L D Walker	

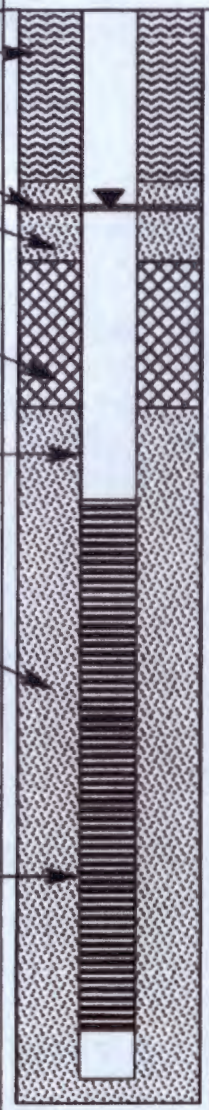
CONSTRUCTION DATA

Description	Diagram
Granular Bentonite Crumbles: 10.01 - 279.0 ft	
Static Water Level: 281.119 ft bgs (11-12-2007)	
10-20 Mesh Colorado Silica Sand: 279.00 - 284.45 ft	
3/8-in Bentonite Pellets: 284.45 - 294.25 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: +1.72 - 300.46 ft	
Primary Filter pack 10-20 Mesh Colorado Silica Sand: 294.25 - 340.00 ft	
4-in I.D. Stainless Steel, Type 304, Slot 20 (.020-in) Screen: 300.46 - 335.46 ft bgs	
4-in I.D stainless steel 304/304L Sump with endcap 335.46'→338.46'	

All depths are in feet below ground surface.

Borehole drilled with 11 3/4-in threaded casing 0.0-130.0 ft and 8-in threaded casing 130.-340.0 ft

All temporary drill casing was removed from the ground.



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
270		270-275 Gravelly Sand gS
		275-280 Silty Gravel mG
280		280-285 Sandy Gravel sG
		285-300 Gravel G
290		
300		300-302 Sandy Gravel sG 302-305 Sand S
		305-325 Sandy Gravel sG
310		
320		
		325-332 Gravel G
330		332-335 Silty Gravel mG
		335-336 Gravelly Silt gM
		336-~~344~~ Basalt
340		340 LW 12-10-07
		TD = 340 ft.
350		

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 9/26/07
Finish Date: 11/13/07
Page 1 of 1

Well ID: C5852	Well Name: 299-E27-155	Approximate Location: Near C-Farm
Project: 200-BP-5 RI/FS		Other Companies: Freestone Env. Serv.
Drilling Company: Blue Star		Geologist(s): J Fetters, G. Kasza, E. Rincon
Driller:	License #:	

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter 11 3/4" From 0 to 130'
11 3/4" O.D.	0 - 130		Cable Tool: X	Diameter 8" From 130 to 340'
8" O.D.	0 - 334.5		Air Rotary:	Diameter ___ From ___ to ___
	-		A.R. w/Sonic:	Diameter ___ From ___ to ___
	-			Diameter ___ From ___ to ___
	-			Diameter ___ From ___ to ___
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ___ From ___ to ___

Drilling Fluid: NA

Total Drilled Depth: 340	Hole Dia @ TD: 8"	Total Amt. Of Water Added During Drilling: NA	
Well Straightness Test Results: Passed		Static Water Level: 280.92	Date: 11/6/07

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	0 - 130'	10/2/07		-	
	130' - 340'	10/29/07		-	
	-			-	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4" s.s. (304/304L) Sch. 10	+1.72 - 300.46	X	NA	Portland cement seal	0 - 10.01	5 gal.	—
4" ss (304/304L) screen	300.46 - 335.96	X	20 slot	Granular bentonite	10.01 - 279.00	171 50lb bags	#8
4" ss. 304/304L Sump	335.46 - 338.96	x	NA	10-20 CSS	279.00 - 284.45	3 50lb bags	10-20
	-			bentonite pellets	284.45 - 294.25	15 gal.	3/8"
	-			10-20 CSS	294.25 - 340	22 50lb bags	10-20

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decomposition:	Yes:	No:	Date:
Description:		Description:			

WELL SURVEY DATA (if applicable)

Not Surveyed at this time	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Reported By:	Title:	Signature:	Date:
Jeff Fetters	geologist	[signature]	11/14/07

A-6003-658 (04/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
299-E27-155	CS852	Not 7th St. of HO-527 Near C-Form	11/12/07

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ☒ No | Does the well have a cement pad? ☒ Yes ○ No

PART 1

STATIC WATER LEVEL:

Start of Job	281.19
End of Job	

DEPTH TO BOTTOM:

Start of Job	338.58
End of Job	

PART 2

WELL DEVELOPMENT DATA

Pump Model	5 hp
Intake Depth	331.03 bgs
Starting Turbidity	53.7 NTU

Pump Start	Stop	Flow Rate
1022	1123	≈30 gpm
~~1123 SF Hole~~		
1133	1143	≈20 gpm

Total Pumped	≈ 2200
Final Turbidity	266
XD SN/Range (PSI)	

PART 3

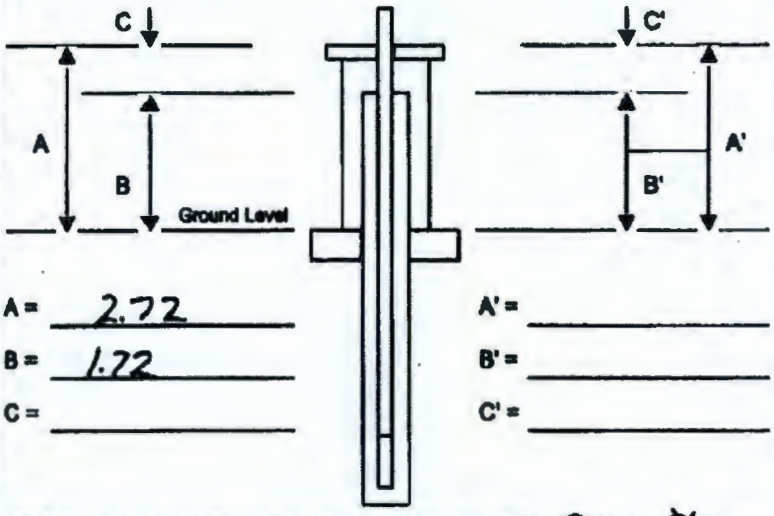
INSTANTANEOUS SLUG TEST

Static Water Level (TOC)	
Transducer Depth	
Baseline Start	
Injection Start	
Baseline Start	
Withdrawal Start	
Slug Volume	
XD SN/Range (PSI)	

PART 4

Last Recorded Measurements Date.

Current Measurements Date:



A =	2.72	A' =	
B =	1.72	B' =	
C =		C' =	

Are there any reference marks on the casing strings? ○ Yes ☒ No

PART 5

COMMENTS:

Test #1 Drawdown

Test #2 Recovery

Prepared by (print name):	Signature:	Date:
J. Fehers	[signature]	11/12/07
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker	[signature]	12/10/07

A-6003-844 (03/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
299-E27-155	C5852	N of 7th St. S of MO-527 Near C Farm	11/12/07

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? O Yes ☒ No

Does the well have a cement pad? ☒ Yes O No

PART 1

STATIC WATER LEVEL:

Start of Job 281.19

End of Job

DEPTH TO BOTTOM:

Start of Job 338.58

End of Job

PART 2

WELL DEVELOPMENT DATA

Pump Model 5 hp

Intake Depth 305.05' bgs

Starting Turbidity

Pump Start	Stop	Flow Rate
1334	1412	30

Total Pumped ≈ 1500 gal

Final Turbidity 1.93

XD SN/Range (PSI)

PART 3

INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

Withdrawal Start

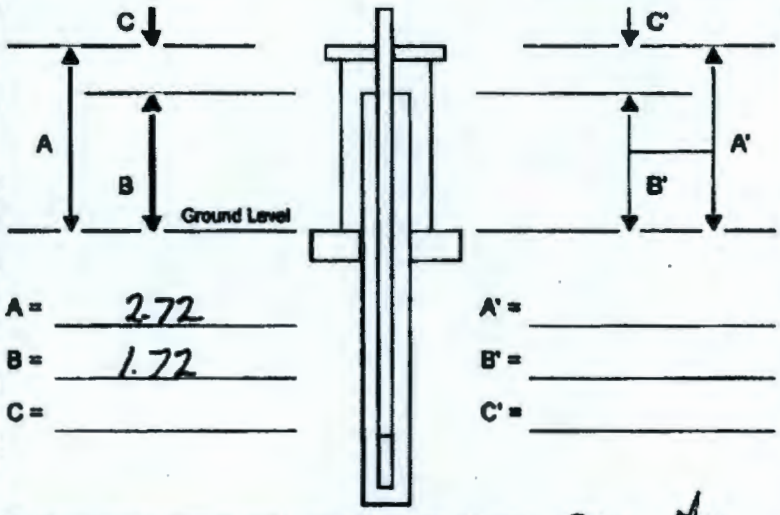
Slug Volume

XD SN/Range (PSI)

PART 4

Last Recorded Measurements Date:

Current Measurements Date:



A = 2.72

B = 1.72

C =

A' =

B' =

C' =

Are there any reference marks on the casing strings? O Yes ☒ No

PART 5

COMMENTS:

Test #3 Drawdown

Test #4 Recovery

Prepared by (print name):	Signature:	Date:
J. Fetters	J. Fetters	11/12/07
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker	L.D. Walker	12/10/07

A-6003-644 (03/03)

WELL SURVEY DATA REPORT

Project:	**Prepared By:** S. Wray **Company:** FGG
Date Requested: 4/14/08	**Requestor:** C.S. Wright (FH)
Date of Survey: 4/17/08	**Surveyor:** S. Wray FGG Survey Dept.
ERC Point of Contact:	**Survey Co. Point of Contact:** N. Fastabend (FGG)
Description of Work: Civil Survey of Groundwater Monitoring Well #C5852 (299-E27-155)	**Horizontal Datum:** NAD83(91) **Vertical Datum:** NAVD88 **Units:** METERS **Hanford Area Designation:** 200E

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments: Gablemtn (FH), 2E-33 (FGG)

Vertical Control Monuments: 2E-33 (FGG), 2E-48 (FGG)

Well ID	Well Name	Easting	Northing	Elevation	
C5852	299-E27-155	575003.11	136429.08		Center of Casing
				208.524	Top Pump Baseplate, N. Edge
				208.517	Top of Casing, N. Edge
				207.680	Brass Survey Marker

Notes:

EQUIPMENT USED: TRIMBLE GPS 5800 RTK
TRIMBLE DiNi 12 LEVEL

Surveyor Statement:
I, Larry A. Henke, a Professional Land Surveyor registered in the State of Washington (Registration No. 38975), hereby certify that this report is based on a field survey performed in April, 2008 under my direct supervision, and that the data contained here is true and correct.

LARRY A. HENKE
STATE OF WASHINGTON
APR. 17 2008
38975
REGISTERED
PROFESSIONAL LAND SURVEYOR
EXPIRES Sept. 23, 2009

Original to:
Distribution by DIS:

Table A-1. Sample Depths and HEIS Numbers for C5852. (2 sheets)

Sample Depth (ft bgs)	Sample Method	HEIS #
250	Quart Grab	B1PMY9
252.5	Quart Grab	B1PN00
255	Quart Grab	B1PN01
257.5	Quart Grab	B1PN02
260	Quart Grab	B1PN03
262.5	Quart Grab	B1PN04
265	Quart Grab	B1PN05
267.5	Quart Grab	B1PN06
270	Quart Grab	B1PN07
271.0-273.5	Split-Spoon	B1PMV9, B1PMW3, B1PMW4, B1PMX8
273.5	Split-Spoon	B1PN08
273.5-276.0	Split-Spoon	B1PMY2
275.0	Quart Grab	B1PN09
277.5	Quart Grab	B1PN10
279.5	Quart Grab	B1PN11
279.5-282.0	Split-Spoon	B1PMY3
284.5-287	Split-Spoon	B1R107, B1R108, B1R109, B1R110, B1R0Y5,
284.5	Quart Grab	B1RY07
286.5	Quart Grab	B1R0Y8
287-289.5	Split-Spoon	B1R0Y6
289.5	Quart Grab	B1R0Y9
292	Quart Grab	B1R100
292-294.5	Split-Spoon	B1R101
292	Groundwater Sample	B1R105, B1R106
295	Quart Grab	B1PN12
297	Quart Grab	B1PN13
300	Quart Grab	B1PN14
302	Quart Grab	B1PN15
302.2-304.7	Split-Spoon	B1PMW0, B1PMW5, B1PMW6, B1PMX2, B1PMX9
302.2-304.7	Split-Spoon (dup.)	B1PN76, B1PN77, B1PN78
305	Quart Grab	B1PN16
304.9-307.4	Split-Spoon	B1PMY4
306.5	Quart Grab	B1PN17

Table A-1. Sample Depths and HEIS Numbers for C5852. (2 sheets)

Sample Depth (ft bgs)	Sample Method	HEIS #
307.5	Groundwater Sample	B1PMH2, B1PMH3 (VOA)
310.5	Quart Grab	B1PN18
311.4	Quart Grab	B1PN19
311.4-313.9	Split-Spoon	B1PMY5
315	Quart Grab	B1PN20
317.5	Quart Grab	B1PN21
319.5	Quart Grab	B1PN22
322	Quart Grab	B1PN23
322-324.5	Split-Spoon	B1PMW1, B1PMW7, B1PMW8, B1PMX3, B1PMY0
324.2	Quart Grab	B1PN24
324.2-326.8	Split-Spoon	B1PMY6
327	Quart Grab	B1PN25
327.5	Groundwater Sample	B1PMH4, B1PMH5 (VOA)
330	Quart Grab	B1PN26
332	Quart Grab	B1PN27
332-345.5	Split-Spoon	B1PMY7
334.5	Quart Grab	B1PN28
335.5	Quart Grab	B1PN29
335-336	Split-Spoon	B1PMW2, B1PMW9, B1PMX0, B1PMX4, B1PMY1
336 (Top of basalt)	Groundwater Sample	B1PMH6, B1PMH7 (VOA)

Notes:

bgs= below ground surface
HEIS = *Hanford Environmental Information System* database
VOA = volatile organic analysis

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APPENDIX B

WELL DOCUMENTATION FOR 699-52-55A (C5861)

Borehole Log

Photographic Log

Well Summary Sheet

Well Construction Summary Report

Well Development and Testing Data

Well Survey

Sample Depths and HEIS #s

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BOREHOLE LOG

Page 1 of 5
Date: 11/20/07

Well ID: C5861 | Well Name: 699-52-55A | Location: 600 Area N of RR, S. of 699-53-55A

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
5	grab			0-3' - wind blown Deposits (Eolian)	Cable Tool, 11 3/4" OD
				5' Gravel (G) 90% gvl, 5% Silt, 5% Sand;	threaded casing
				gvl: 70% basalt 30% qtz/others, 10cm-2mm (sc-VFP), R, Predom VCP; Sand: M-VF, R-SR,	
				70% basalt 30% qzt; Silt: Dry, no Rxn HCl,	
10	grab			10YR 4/3 brown	10' Suspect larger gvls.
				10' Silty Sandy Gravel (msG) 60% gvl 10%	
				Sand, 30% Silt; gvl: 6cm-2mm (VCP-VFP) R-SR,	12' 20cm basalt
				80% basalt, 20% qzt; Sand: VC-VF, A, 60%	boulder
				basalt 40% qzt/others; Silt: Dry 10YR 4/1 Dk	
15	grab			gray, Mod Rxn HCl	
				15' - Silty Sandy Gravel, same	Drilling rate ↓
				lithology as above	
20	grab			19' - Sand (s) 90% Sand 10% gvl; gvl: 9cm-2mm	19' Dr ↑.
				(Sc-VFP), 90% basalt 10% qtz/others, R; Sand:	
				VC-M, 90% basalt 10% qtz/others, SR-SA,	
				Dry, no Rxn HCl, 9ley 1 2.5/10y greenish	
				black	
25	grab			25' - Sand (s) same lithology as	
				above, 100% basalt gvls.	
30	grab			30' - gravelly Sand (gS) lithology same	
				as above w/ gvls to 20% gvl are 80%	
				basalt 10% qtz/others	
33	grab			33' Sandy gravel (sG) 40% gvl 60% Sand; gvl:	
				9cm-2mm (Sc-VFP), R, 70% basalt, 30% qtz;	
35				Sand: VC-F, 70% basalt 30% qtz, SR, SA, Vwk	
				Rxn HCl, Dry, 10YR 3/2 VDk grayish	
				brown, Trace of Clay	
				35' sandy gravel (sG) 75% gvl 25% Sand; gvl: 90%	35' Sand predom M
				basalt 10% qtz 6cm-2mm (VCP-VFP), R; Sand: VC-	grained
40	grab			VF, 60% basalt 40% qtz, Dry, 10YR 3/2 VDk grayish	41' increase in "pea"
				brown Vwk Rxn HCl	sized gvls. & Silt
				40' gravel (G) 80% gvl 20% Sand; gvl 90% basalt 10%	
				qzt, R, 2cm-2mm (VCP-VFP); Sand: 70% basalt 30%	43' Casing driving very
				qzt, SA-SR, VC-M, Dry, 10YR 3/2 no Rxn HCl	hard.

Reported By: J Fellers | Reviewed By: L. D. Walker

Title: geologist | Title: Geologist

Signature: [signature] Date: 11/27/07 | Signature: [signature] Date: 2/1/08

A-6003-642 (03/03)

BOREHOLE LOG

Page 2 of 5
Date: 11/27/07

Well ID: C5861 | Well Name: 699-52-55A | Location: 600 area MOFRR, S.of 699-53-55A

Project: 200 - BP-5 Ri/Fs | Reference Measuring Point: Ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
45	grab			45' Silty Sandy Gravel (msG) 70% gvl 15% snd 15% Silt; Gvl: 10cm-2mm (SC-VFP) 70% basalt 30% qzt, R; Snd: 60% qzt 40% basalt, VC-VF Predom M-VF, SA-SR; Silt: Dry, mod Rxn HCl 2.5y 3/2 vDk gray brown	Cable Tool 11 3/4" Casing 46' ↑ Silt Content
50	grab			50' - Silty Gravel (msG) 70% gvl 5% snd 25% Silt; Gvl: 70% basalt 30% qzt, R, 12cm-2mm (SC-VFP); Silt: Moist, 10YR 3/2, wk Rxn HCl; Snd: lithology Same as above	53' Dr ↓. Casing driving hard.
55	grab			55' - Silty Sandy gravel (msG); 60% gvl 20% snd 20% Silt; Gvl: 40% qzt 60% basalt, R, 7cm-2mm (SC-VFP); Snd: 70% qzt 40% basalt, VC-VF (Predom M-F) SA-A; Silt: Slightly Moist, 2.5y 4/2 Dk grayish brown, Vwk Rxn HCl	
58	grab				
60	grab			58' - Silty Sandy Gravel (msG); 50% snd 40% gvl 10% Silt; gvl: 60% basalt 40% qzt, 5cm-2mm, R; Snd: 50% basalt 50% qzt, A, SA, VC-VF (Predom M-F); Silt: Dry, 7.5y 4/2, brown Vwk Rxn HCl	
				60' - lithology Same as above	64' DR ↑
65	grab			65' - Gravel (G) 80% gvl 10% snd 10% silt: gvl: 50% basalt 50% qzt, 11cm-3mm, R; Snd: VC-VF (Predom VC-C) 50% basalt 50% qzt, SA-A; Silt: Slightly Moist: 10YR 4/2 Dk grayish brown Vwk to mod Rxn HCl	65' Moisture ↑ 67' DR ↓ 68: noticable amount of vesicular basalt Cobbles
70	grab			70' - lithology Same as above	
					74' Casing reduced From 11 3/4" - 8"
75	grab			75' - lithology Same as above	
80	grab			79' - Sandy Gravel (SG); 70% gvl 30% snd: gvl: 60% basalt 40% others, R, 12cm-2mm (SC-VFP); Snd: VC-VF Predom F-VF, 90% qzt 10% basalt, A-SA, Dry, Vwk Rxn HCl, 2.5y 4/2 Dk grayish brown	79' Suspect gvl >20 cm due to high amounts of Fresh broken Clasts.

Reported By: J Fellers | Reviewed By: L. D. Walker

Title: geologist | Title: Geologist

Signature: J Fellers | Date: 11/30/07 | Signature: L D Walker | Date: 2/1/08

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 5
Date: 12/4/07

Well ID: C5861 | Well Name: 699-52-55A | Location: 600 area N of RR, S. of 699-53-55A

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
85	grab			85'- Sandy gravel, lithology same as above	Cable Tool, 8" casing 85' noticable ~~amounts~~ amounts of vesicular basalt cobbles
90	grab			90'- Silty Sandy Gravel (msG) 60% gvl 30% sand 10% silt; gvl: 80% basalt 50% qtz, 12cm-2mm (sc-VFP) R; Sand: 90% qtz 10% basalt, vc-UF (Predom F-UF) A-SA; Silt: Moist, 10YR 4/3 Brown, Vwk Rxn HCl	90'- Suspect larger gvls >20cm, ↑ moisture clasts coated w/ moist silt 91' ↓ moisture
95	grab			95'- lithology same as above, silt is Dry	
100	grab			100'- lithology same as above	
105	grab			105'- Sandy gravel (sG) 70% gvl 30% sand; gvl: 6cm-2mm (vcc-VFP) 60% qtz 40% basalt, R; Sand 90% qtz 10% basalt, vc-VF (Predom F-UF) Dry, 7.5Y 4/2 brown, Vwk Rxn HCl	105' suspect larger gvls due to amount of freshly broken angular clasts
110	grab			110'- gravel (g) 90% gvl 10% sand; gvl: 10cm-2mm (sc-VFP) 50% basalt 50% qtz, R, (suspect larger gvls >10cm); Sand: vc-VF 80% qtz 20% basalt, A-SA, Dry, 7.5Y 4/2 brown, Vwk Rxn HCl, Slight (weak) cementation	111' DR ↓
115	grab			115'- Silty Sandy Gravel (msG) 80% gvl 10% sand 10% silt gvl: 50% basalt 50% qtz, R, 10cm-2mm; sand: 50% b, 50% qtz, M-VF, A; Silt: Dry, 5Y 4/1 Dk gray, Vwk Rxn HCl	
120	grab			120'- lithology same as above	
123	grab			123'- gravelly silty sand (gmS) 60% sand, 30% gvl, 10% silt; gvl: 50% basalt 50% qtz, R, 4cm-2mm (vcP-VFP); Sand: 60% qtz 40% basalt; vc-VF, A-SA; Silt Dry, 10YR 4/2 Dk grayish brown, Mod Rxn HCl, Mod cementation	123' gravels size ↓.

Reported By: J Fetters | Reviewed By: L. D. Walker

Title: geologist | Title: Geologist

Signature: J Fetters | Date: 1/21/08 | Signature: L D Walker | Date: 2/1/08

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 5
Date: 12/6/07

Well ID: C5861 | Well Name: 699-52-55A | Location: 600 Area N of RR, S of 699-53-55A

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Drilving Sampling Tool, Sampler Size, Water Level
125	grab			125'- lithology same as above, color to 7.5y 4/2 Brown	Cable Tool 8" casing
130	grab			130'- gravelly Sand (gS) 70% snd 30% gvl: gvl: 50% basalt 50% qtz, R, 4cm-2cm (VCR-VFR) Snd: 60% qtz 40% basalt, A-SA, Dry, 5y 4/2 olive gray, wk Rxn HCl	
135	grab			135'- gravelly silty sand (gm S) 70% snd 20% gvl 10% silt: 80% qtz 20% basalt, A-SA, VC-VF (Predom M-VF); gvl: 50% basalt 50% qtz, R-SR, 5cm-2mm (VCC-VFF); silt: Dry, 5y 5/2 olive gray, mod Rxn HCl	135' basalt, snd grains larger than qtz/others
140	grab			139: silty gravelly sand (msG); 40% gvl 40% snd 20% silt; gvl: 50% basalt 50% qtz, R, 5cm-2mm (VCC-VFF); snd: 80% qtz 20% basalt, A-SA M-VF; Dry 10YR 5/2 grayish brown, mod Rxn HCl	139' ↑ sand size & gvl: % 141- cuttings not staying in Drive barrel ↑ gvl size 144 ↑ silt content
145	grab			142' lithology same as above w/ wk cementation, strong Rxn HCl	145'- grab sample, snd Predom F-VF
148	grab			145'- gravelly silt (gm) 80% silt 20% gvl; gvl: 50% basalt 50% qtz, R, 6cm-2mm; snd: VC-VF, 80% qtz 20% basalt, A-SA; silt: Dry, 10YR 6/2 lt. brownish gray, mod Rxn HCl	148' grab sample
149	grab				149' grab sample
150	grab			147-147.5 silt (M) slightly moist, wk-mod Rxn HCl, 10YR 4/2 dk grayish brown	
152	grab			148' lithology same as above	152'- grab sample
155	grab			151'- silt (m): slightly moist, 5y 5/3, olive, wk Rxn HCl, Rust Red mottling present	155' grab sample, Red-orange mottling
157	grab			153'- lithology same as above	
160	grab			155'- sandy silt (sM) 50% snd 50% silt; snd: VF, 80% qtz 20% basalt, A-SA; silt: slightly moist, 5y 4/3 olive wk Rxn HCl	157'- grab sample
163	grab			157: sand (s): VF, slightly moist, 5y 5/3 olive, mod Rxn HCl, A-SA, no mottling present	158'- Predom M-VF snd.
				158'- silty sand (mS) 80% snd 15% silt 5% gvl: gvl 2cm-2mm, R, 50% basalt 50% qtz; snd: VC-VF, A-SA, 80% qtz 20% basalt; silt Dry 2.5y 5/2 grayish brown, wk Rxn HCl	160' grab sample
					163' grab sample

Reported By: J Fetters | Reviewed By: L. D. Walker

Title: geologist | Title: Geologist

Signature: J Fett | Date: 12/6/07 | Signature: LD Walker | Date: 2/1/08

A-6003-642 (03/03)

BOREHOLE LOG

Page 5 of 5
Date: 12/10/07

Well ID: C5861 | Well Name: 699-52-55A | Location: 600 area N of RR S of 699-53-55A

Project: 200-BP-5 RI/FS | Reference Measuring Point: ground

Depth (FL)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
165	grab			165- lithology same as above, w/ mod rxn HCl	Cable Tool 8" casing 165' grab sample
167.5	grab				
170	grab			170'-gravelly sand (gS): 80% sand 20% gvl: 50% basalt, 50% qtz, SA-SR, 2cm-2mm (CP-VFP); Sand: VC-VF (Predom M-F) 70% basalt 30% qtz, A, Dry, 10YR 4/2 Dk grayish brown, wk rxn HCl, Basalt = larger grain size	170' grab sample
173.5	grab			173.5- lithology same as above, gvl. ↑ to 3cm.	173.5' grab sample
175	grab	65 174-176.5 75%		175'- Silty gravelly sand (SgS) 80% sand 15% gvl, 5% silt; Gvl: 60% basalt 40% qtz, R, 2cm-2mm (CP-VFP), Sand: VC-VF (Predom C-VC) 60% basalt 40% qtz, A; Silt: wet, no Rxn HCl 10YR 3/2 VDK grayish brown	175' grab sample S.S. 174-176.5- S.S. encountered large cobble, shoe damaged could not be removed, contents dumped into bowl.
180				177.2- Basalt; present as chips + fines in drill cuttings; non-vesicular basalt; very dark gray to black in color; 20-25% (by mass) sand, same lithology as sand above.	
185					183.32' = T.D. (1/4/08) Static W.L. = 173.5 (12/11/07)
190					

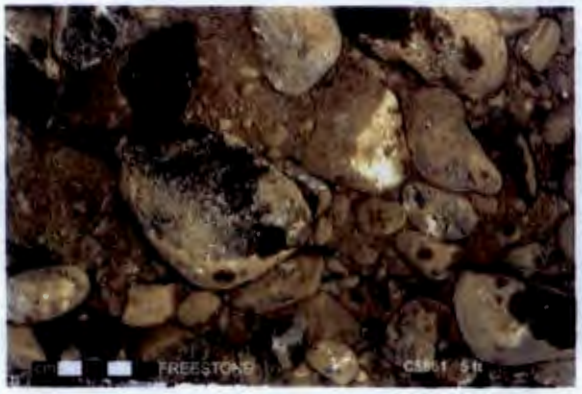
Reported By: J Fetters | Reviewed By: L.D. Walker

Title: geologist | Title: Geologist

Signature: [signature] Date: 1/28/08 | Signature: [signature] Date: 2/1/08

A-6003-642 (03/03)

Well C5861



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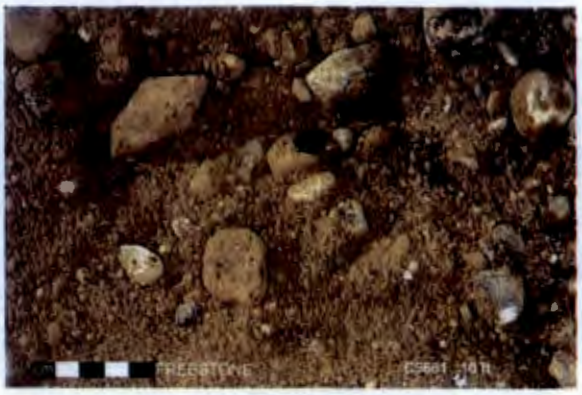

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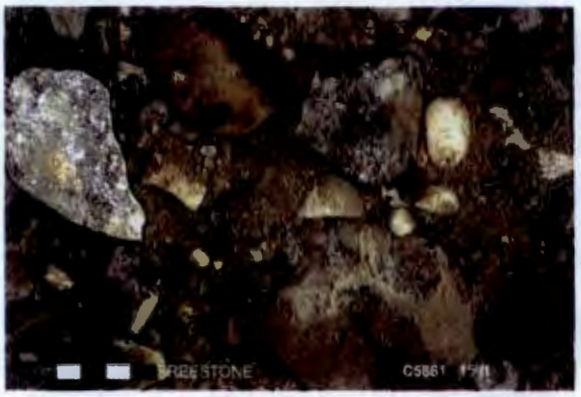

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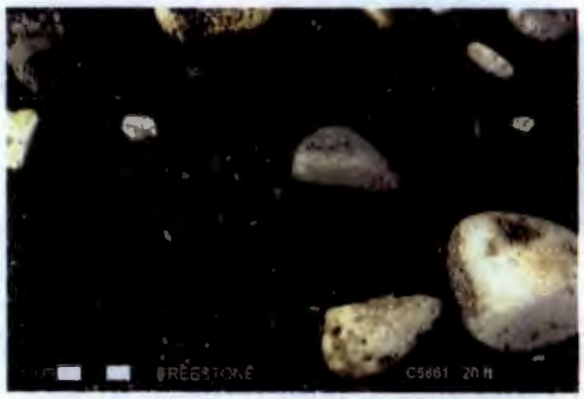

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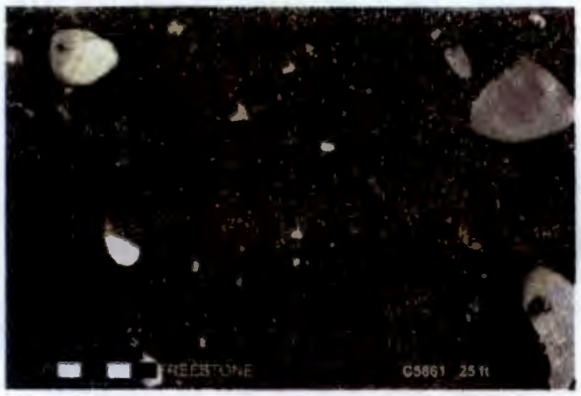

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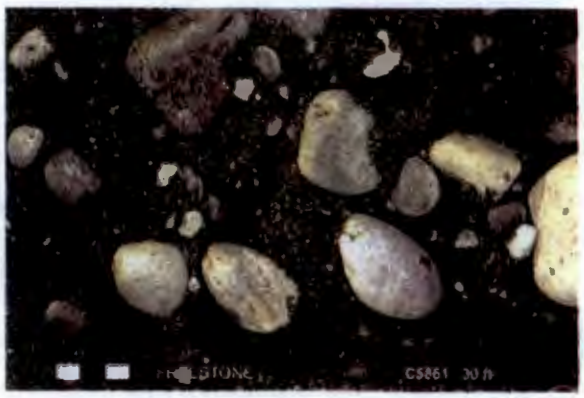

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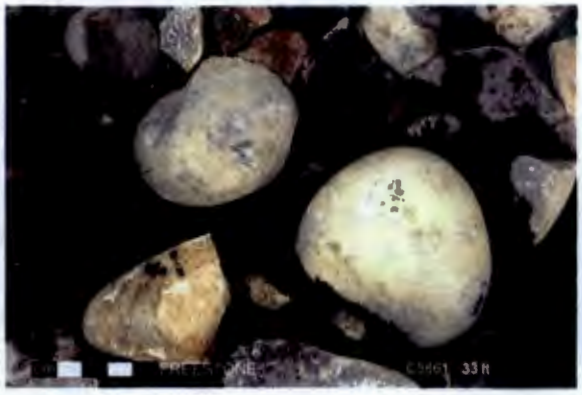
Well C5861



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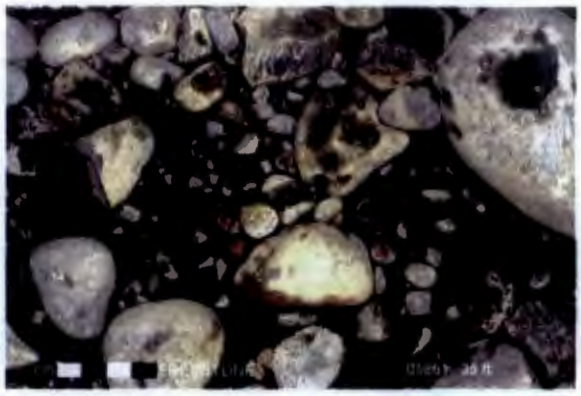

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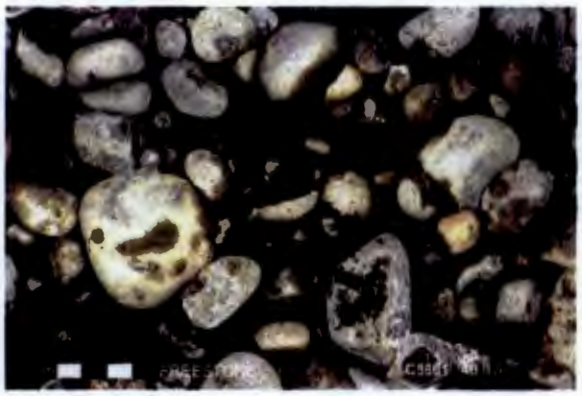

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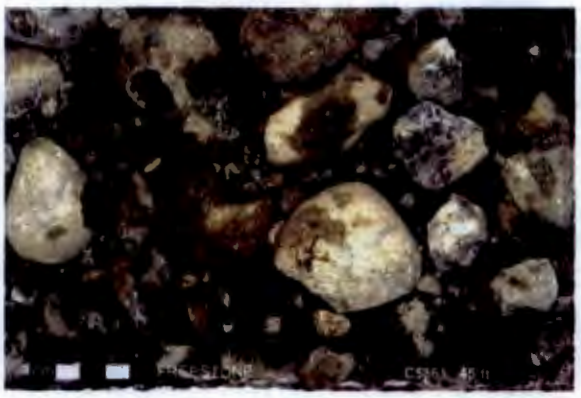

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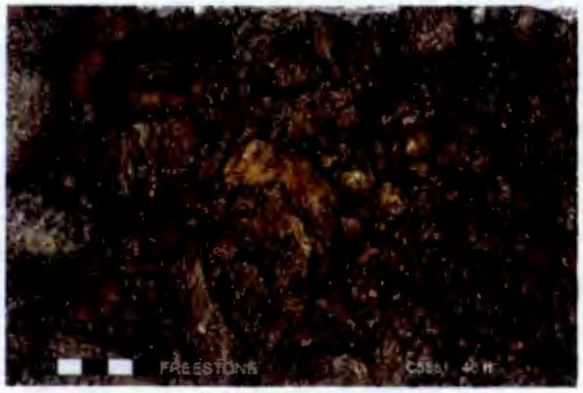

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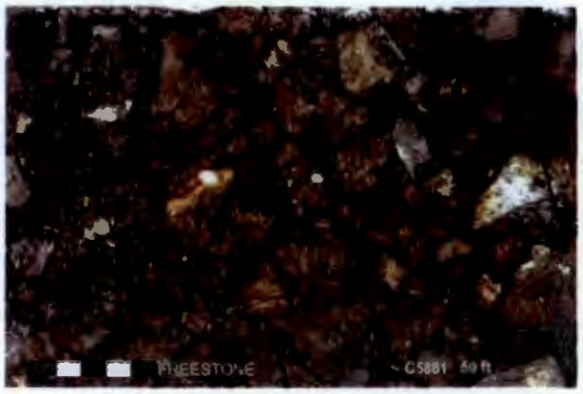
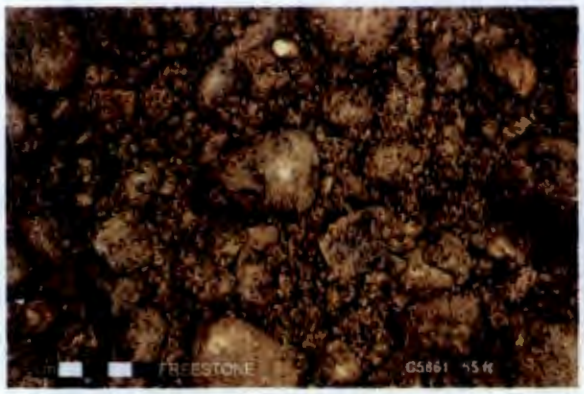


50 ft

Well C5861



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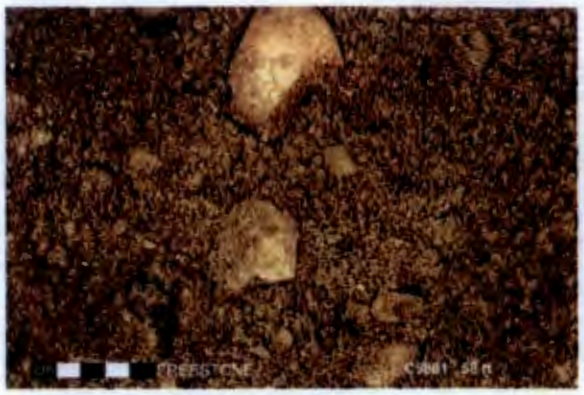

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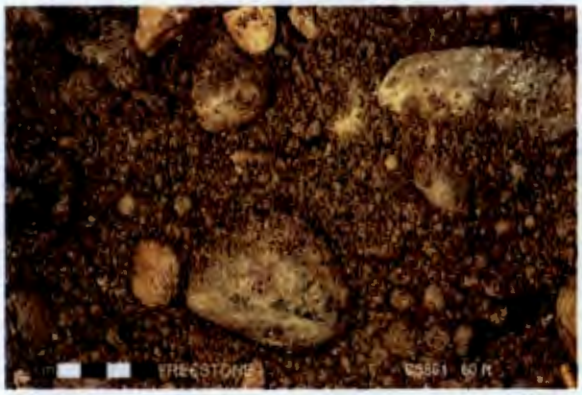

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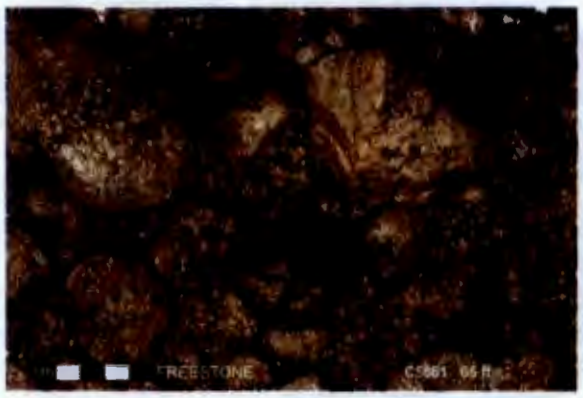

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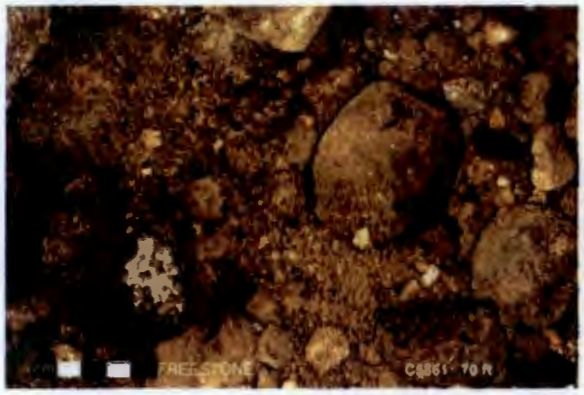

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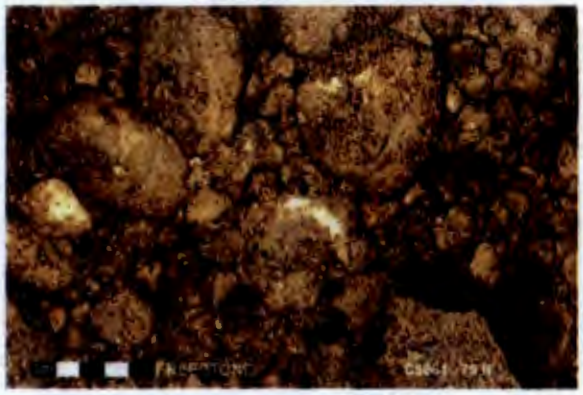

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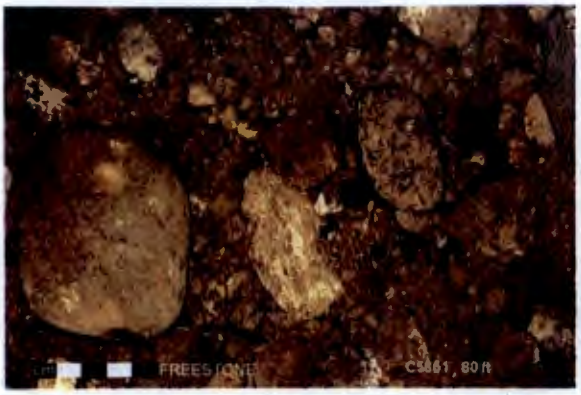
Well C5861



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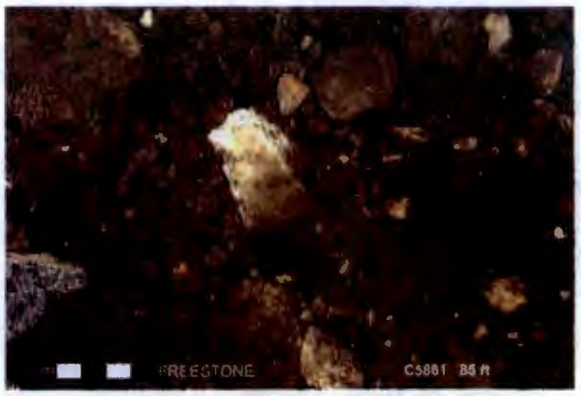

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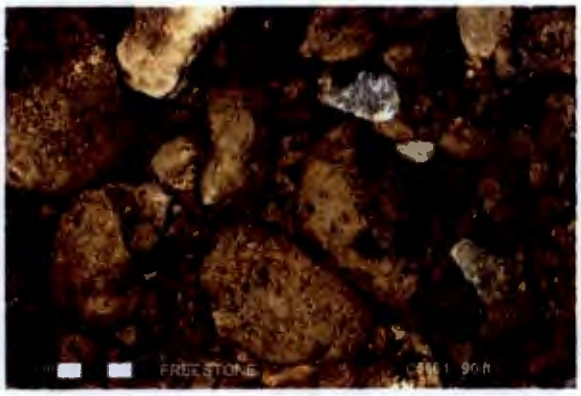
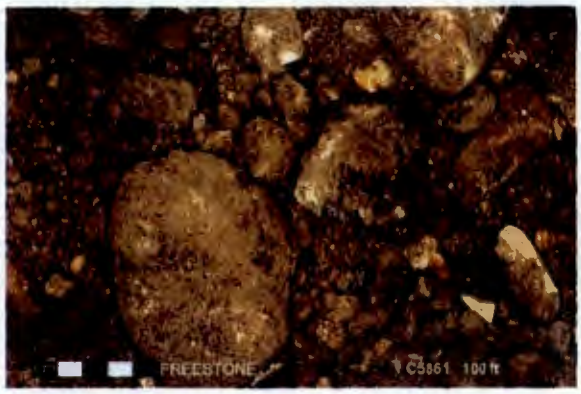


90 ft

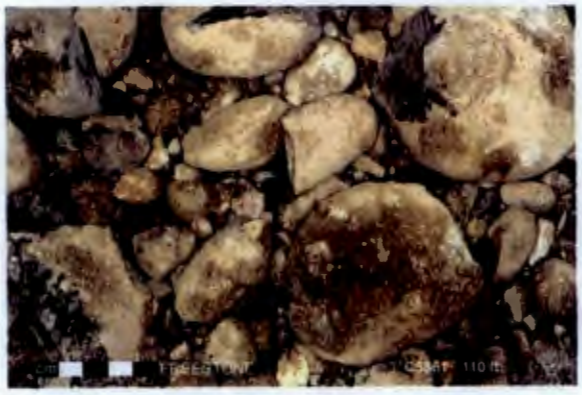
95 ft



100 ft

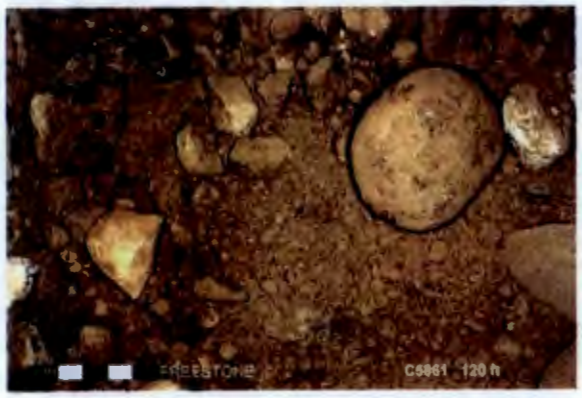
105 ft

Well C5861



110 ft

115 ft



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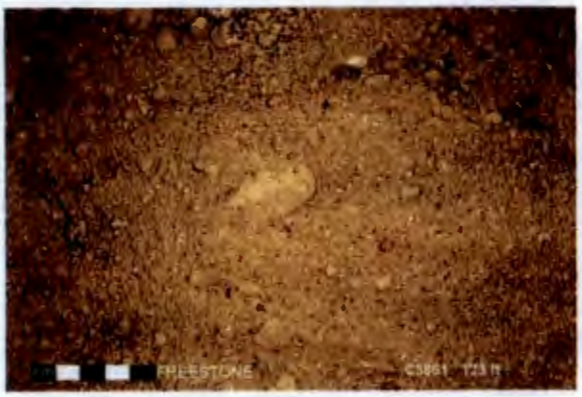

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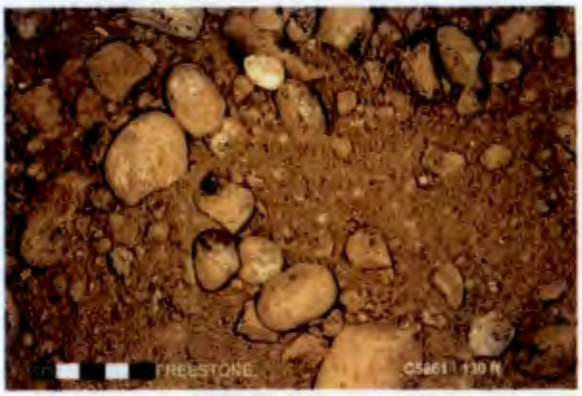
125 ft



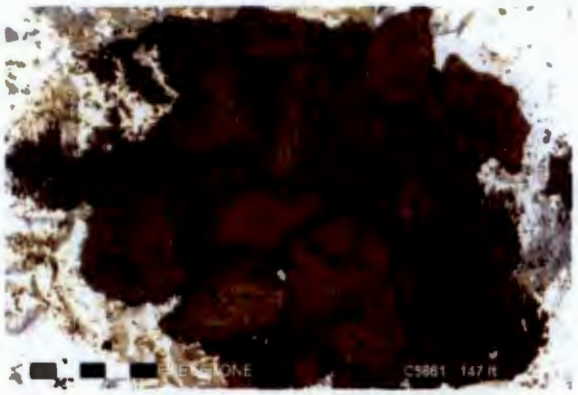
130 ft

Well C5861

135 ft

140 ft

145 ft



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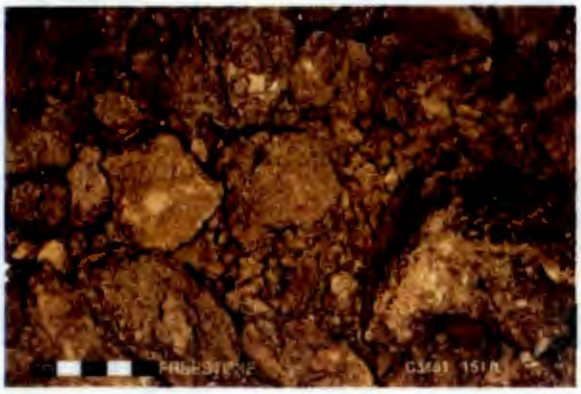

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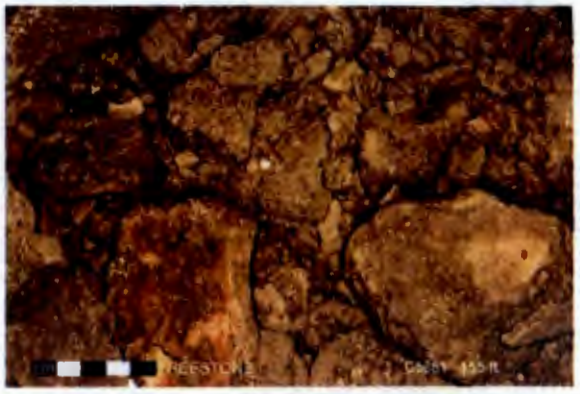

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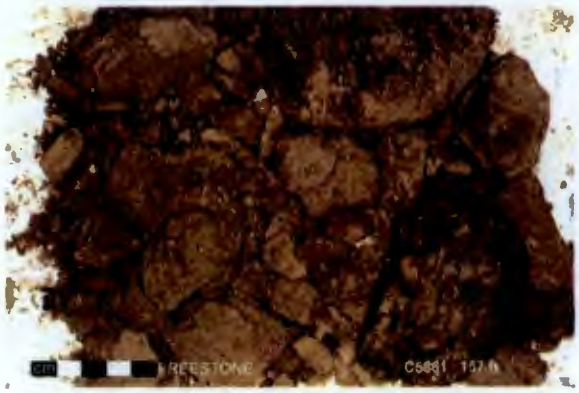
Well C5861



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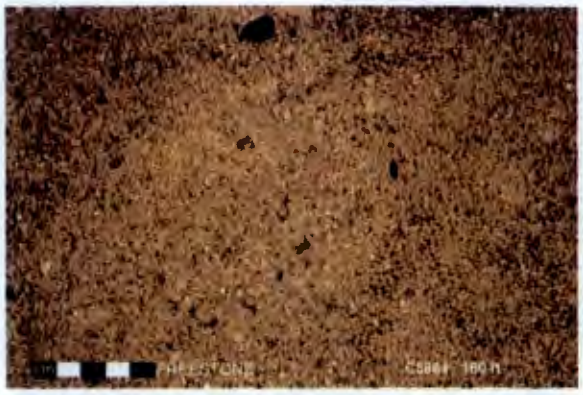

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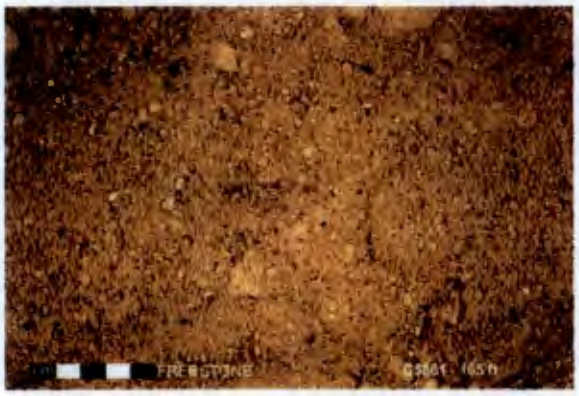

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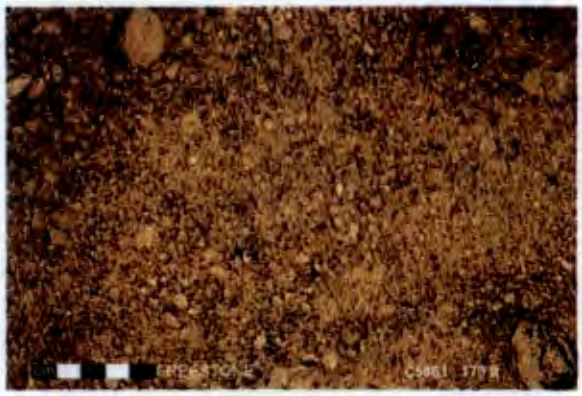

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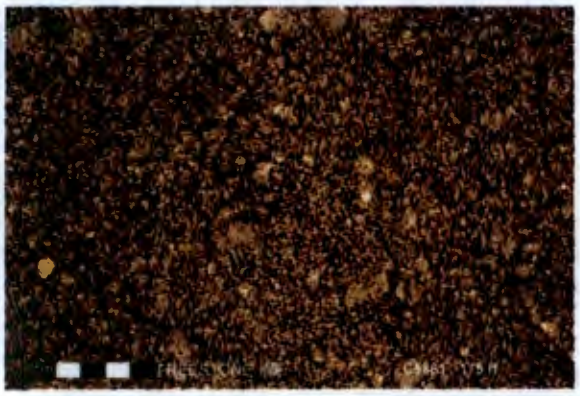

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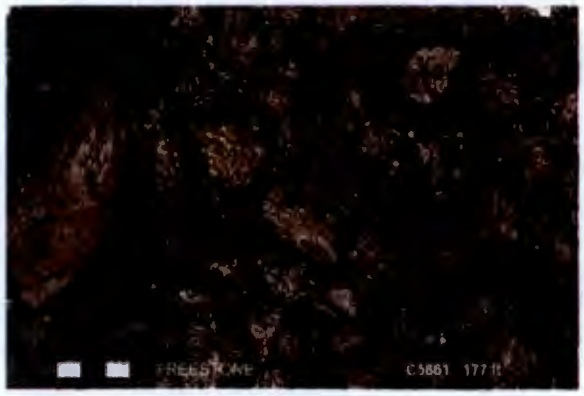
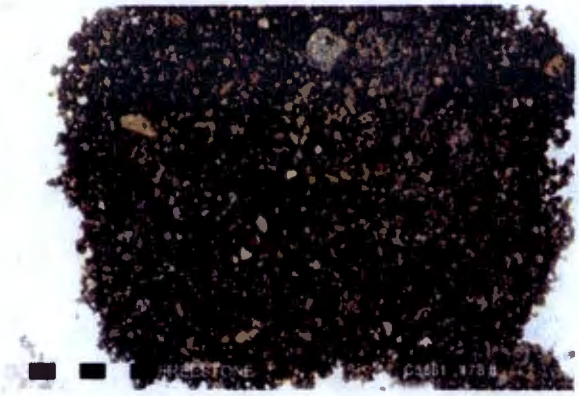


177 ft

Well C5861



178 ft

183 ft

WELL SUMMARY SHEET	Start Date: 11/20/07 Finish Date: 1/22/08	Page 1 of 3

Well ID: C5861		Well Name: 699-52-55A	
Location: 600 Area N. of R.R., S. of 699-53-55A		Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters / GKASZA	Date: 1/9/08	Reviewed By: L. A. Walker	Date: 1-30-08
Signature: Jeff Rosza		Signature: Geologist - LW 1-30-08	

CONSTRUCTION DATA

Description	Diagram
12-in Flush Mount Well Head 12-in Protective Casing: 0-1.5 ft bgs 6-in I.D. Type 304/304L Stainless Steel Protective Casing: 0.5-3.5 ft bgs with locking well cap Portland Cement Type I/II: 0 - 9.8 ft bgs Granular Bentonite Crumbles: 9.8 - 156.1 ft bgs 4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: -1.1 - ~~180.1~~ ft bgs 169.8' LW 1-30-08 All depths are in feet below ground surface. Borehole drilled with 11 3/4-in threaded casing 0.0-74.0 ft and 8-in threaded casing 74.0-176.8 ft All temporary drill casing was removed from the ground.	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
0		0-3 Eolian deposits (Sand)
		3-10 Gravel G
10		10-19 Silty Sandy Gravel msG
20		19-30 Sand S
30		30-33 Gravelly Sand gS
		33-40 Sandy Gravel sG
40		40-45 Gravel G
		45-50 Silty Sandy Gravel msG
50		50-55 Silty Gravel mG
		55-65 Silty Sandy Gravel msG
60		
		65-79 Gravel G
70		
80		79-90 Sandy Gravel sG

WELL SUMMARY SHEET	Start Date: 11/20/07 Finish Date: 1/22/08	Page 2 of 3

Well ID: C5861	Well Name: 699-52-55A
Location: 600 Area N. of R.R., S. of 699-53-55A	Project: 200-BP-5 RI/FS
Prepared By: Jeff Fetters / [illegible] Date: 1/9/08	Reviewed By: L. D. Walker Date: 1/30/08
Signature: [illegible]	Signature: [illegible]

CONSTRUCTION DATA

Description	Diagram
All depths are in feet below ground surface. Borehole drilled with 11 3/4-in threaded casing 0.0-74.0 ft and 8-in threaded casing 74.0-176.8 ft All temporary drill casing was removed from the ground.	
Granular Bentonite Crumbles: 9.8 - 156.1 ft	
4-in I.D. Type Stainless Steel Type 304/304L, Schedule 10 Permanent Casing: -1.1 - ~~189.1 ft~~ 169.8' LW 1-30-08	
3/8-in Bentonite Pellets: 156.1 - 160.1 ft bgs	
Primary Filter pack 10-20 Mesh Colorado Silica Sand: 160.1 - 183.1 ft bgs	
4-in I.D. Stainless Steel, Type 304, 20 Slot Screen (.020-in): 169.8 - 179.8 ft bgs	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
90		90-105 Silty Sandy Gravel msG
100		
		105-110 Sandy Gravel sG
110		110-115 Gravel G
		115-123 Silty Sandy Gravel msG
120		
		123-130 Gravelly silt gM
130		130-135 Gravelly Sand gS
		135-139 Gravel Silty Sand gmS
140		139-145 Silty Gravel Sand mgS
		145-147 Gravelly Silt gM
		147-155 Silt M
150		
		155-157 Sandy Silty sM
		157-158 Sand S
160		158-170 Silty Sand mS
170		170-175 Gravelly Sand gS
		175-177.2 Silty Gravely Sand mgS
		177.2-183.2 Basalt

WELL SUMMARY SHEET	Start Date: 11/20/07 Finish Date: 1/22/08	Page 3 of 3
Well ID: C5861	Well Name: 699-52-55A	
Location: 600 Area N. of R.R., S. of 699-53-55A	Project: 200-BP-5 RI/FS	
Prepared By: Jeff Fetters / G KASZA — Date: 1/9/08	Reviewed By: L. D. Walker — Date: 1/30/08	
Signature: [signature]	Signature: [signature]	

CONSTRUCTION DATA

Description	Diagram
4-in I.D. Stainless Steel, Type 304, 20 Slot Screen (.020-in): 169.8 - 179.8 ft bgs Primary Filter pack 10-20 Mesh Colorado Silica Sand: 160.1 - 183.1 ft bgs 4-in I.D. Stainless Steel Sump: 179.8-183.1 ft bgs Natural Fill 183.1' → 183.3'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description/Groundwater Sample Depths (ft bgs)
180		177.2-~~183.2~~ Basalt 183.3' LW 1-30-08
190		TD = 183.3' bgs
200		
210		
220		
230		
240		
250		
260		

All depths are in feet below ground surface.

Borehole drilled with 11 3/4-in threaded casing 0.0-74 ft and 8-in threaded casing 74-176.8 ft

All temporary drill casing was removed from the ground.

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 11-20-07
Finish Date: 1-22-08
Page 1 of 1

Well ID: C5862	Well Name: 699-52-55A	Approximate Location: NOF 200 & ON ROAD S OF 6-53-55A
Project: 200-BP-5		Other Companies: —
Drilling Company: BLUE STAR ENTERPRISES NW		Geologist(s): J. FETTERS, P. CASBACE, G. KASZA
Driller: DAVE CURAY	License #:	

TEMPORARY CASING AND DRILL DEPTH

*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.
11 3/4"	0 - 71	
8"	0 - 183.3	≈ 8 1/2
	.	
	.	
	.	

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

ALL FLUSH JOINT
SHOE IS HARD FACED CASING - WELDED, BUILTUP SHOULDER

DRILLING METHOD / HOLE DIAMETER (in.) / INTERVAL (ft)

Auger:	Diameter 12	From 0	to 71
Cable Tool: X	Diameter 8 1/2	From 71	to 183.3
Air Rotary:	Diameter	From	to
A.R. w/Sonic:	Diameter	From	to
	Diameter	From	to
	Diameter	From	to
	Diameter	From	to

Drilling Fluid: POTABLE WATER

Total Drilled Depth: 183.3	Hole Dia @ TD: 8 1/4-1/2	Total Amt. Of Water Added During Drilling: 400 GAL	
Well Straightness Test Results: PASSED 1-8-08		Static Water Level: 173.75 BTOC	Date: 1-22-08

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
	0 - 78.48	12-3-07		.	
	70 - 183	1-7-08		.	
—	.	—		.	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
~~Sch 10 SS. 4"~~	~~-1 - 183.3~~	✓	0.020	~~"TYPE I" BENTONITE~~	0 - -10	~~TYPE~~	
4" ID Sch. 10 SS	-1.1' - 169.8'	FJ	NA	BENTONITE CHIPS	-10 - 110	110	CHIPS
4" ID SS Screen	169.8 - 179.8'	FJ	0.020"	BENTONITE POELETS	156 - 160	3 x 5 GAL	3/8"
4" ID SS Sump	179.8 - 183.1	FJ	NA	10-20 COLORADO SILICA SAND	160 - 183 TD	4 x 55 GAL	10-20
	.				.		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes: / No: / Date:
Description: NONE PERFORMED		Description: NONE PERFORMED	

WELL SURVEY DATA (if applicable)

SURVEY RESULTS NOT AVAILABLE - 1-25-08	Protective Casing Elevation: —
Washington State Plane Coordinates:	Brass Survey Marker Elevation: —

COMMENTS / REMARKS

FLUSH MOUNT SURFACE MONUMENT

Reported By:	Title:	Signature:	Date:
GARY L. KASZA	GEOLOGIST	[signature]	1-25-08

A-6003-658 (04/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
C5861	699-S2-55A	200-BP-5 Near 200E	1-18-08

✓ Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? O Yes ☒ No

Does the well have a cement pad? ☒ Yes O No

PART 1

STATIC WATER LEVEL:

Start of Job	173.75 BTOC
End of Job	N/A

DEPTH TO BOTTOM:

Start of Job	183.05 BTOC
End of Job	N/A

PART 2

WELL DEVELOPMENT DATA

Pump Model	REDIFLO 4
Intake Depth	181.55' BTOC
Starting Turbidity	> 1000 NTU

Pump Start	Stop	Flow Rate
10:10	10:20	6 GPM
10:25	10:36	—
10:38	10:40	—
10:44	10:50	—

Total Pumped	< 5 GAL
Final Turbidity	> 1000 NTU
XD SN/Range (PSI)	9854

PART 3

INSTANTANEOUS SLUG TEST

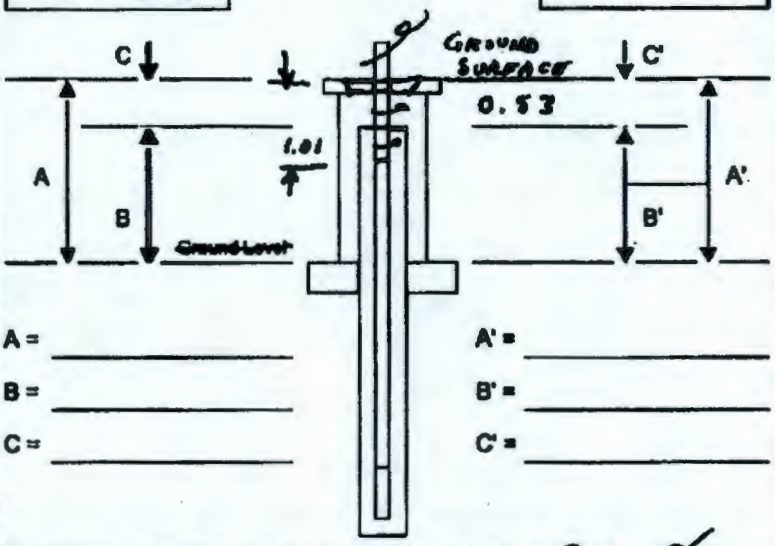
Static Water Level (TOC)	
Transducer Depth	
Baseline Start	
Injection Start	
Baseline Start	
Withdrawal Start	
Slug Volume	
XD SN/Range (PSI)	

PART 4

Last Recorded Measurements Date: 1-18-08

FLUSH MOUNT

Current Measurements Date:



A = _____ A' = _____

B = _____ B' = _____

C = _____ C' = _____

Are there any reference marks on the casing strings? O Yes ☒ No

PART 5

COMMENTS: VARIABLE SPEED PUMP
PUMP INTAKE 1.5' ABOVE BOTTOM OF MOTOR
PUMP OVERLOAD PROTECTOR KICKS OFF ≈ 7 MIN TO GET WATER TO SURFACE.
WELL DEVELOPMENT TERMINATED FOR TODAY

Prepared by (print name):	Signature:	Date:
Greg L. Kasza	Greg Kasza	1-18-08
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker	D Walker	2-1-08

A-6003-644 (03/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
C5861	699-52-55A	200 BP-5 – NOF 200E	1-22-08

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? O Yes ☒ No

Does the well have a cement pad? ☒ Yes O No

PART 1

STATIC WATER LEVEL:

Start of Job	173.75 START OF DAY
End of Job	173.72

DEPTH TO BOTTOM:

Start of Job	183.03
End of Job	—

PART 2

WELL DEVELOPMENT DATA

Pump Model GROUNDFOS REDIFLO 2

Intake Depth 177.9

Starting Turbidity ~~<1000~~ >1000NTU

Pump Start	Stop	Flow Rate
9:54	11:50	4.5GPH
~~11:52~~		
—		
—		
—		

Total Pumped ≈ 9 GAL + 6 BAILS

Final Turbidity 128 NTU

XD SN/Range (PSI) NOT USED

PART 3

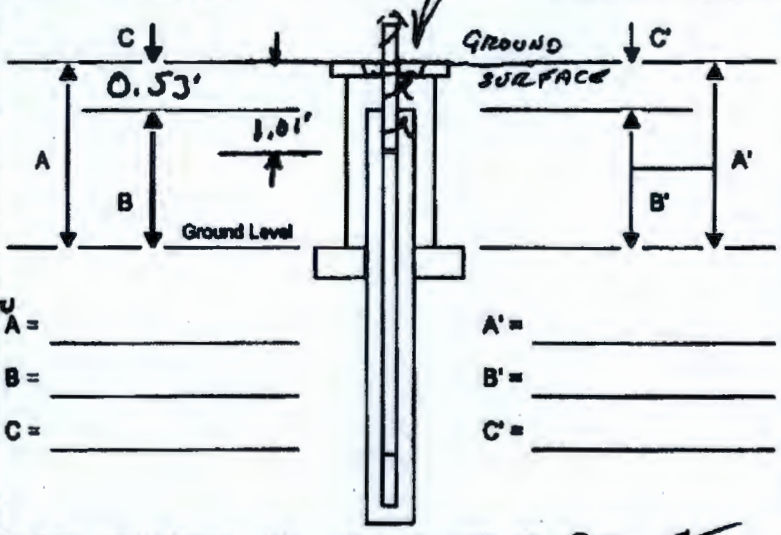
INSTANTANEOUS SLUG TEST

Static Water Level (TOC)	
Transducer Depth	
Baseline Start	
Injection Start	
Baseline Start	
Withdrawal Start	
Slug Volume	
XD SN/Range (PSI)	

PART 4 FLUSH MOUNT

Last Recorded Measurements Date: 1-22-08

Current Measurements Date:



A = _____ A' = _____

B = _____ B' = _____

C = _____ C' = _____

Are there any reference marks on the casing strings? O Yes ☒ No

PART 5

COMMENTS:

BAILED WELL 2X W/ SAND PUMP ≈6 GAL REMOVED

pH METER NOT WORKING

FINAL TURBIDITY: 128 NTU

DO = 8.46 mg/L

COND 478 µS T=8.1°C

AMBIENT AIR ≈15°F.

Prepared by (print name):	Signature:	Date:
Greg L. Krause	[signature]	1-22-08
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker	[signature]	2-1-08

A-6003-644 (03/03)

WELL SURVEY DATA REPORT

Project:	**Prepared By:** N.P. Fastabend **Company:** FGG
Date Requested: 02/14/08	**Requestor:** C.S. Wright (FH)
Date of Survey: 03/07/08	**Surveyor:** N.P. Fastabend FGG Survey Dept.
ERC Point of Contact:	**Survey Co. Point of Contact:** N.P. Fastabend
Description of Work: Civil Survey of Groundwater Monitoring Well C5861 (699-52-55A).	**Horizontal Datum:** NAD83(91)
	Vertical Datum: NAVD88
	Units: Meters
	Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
GABLEMTN (FH), 2E-1 (FGG)

Vertical Control Monuments:
J317 (C.O.E.), K317 (C.O.E.)

Well ID	Well Name	Easting	Northing	Elevation	
C5861	699-52-55A	573102.44	139443.20		Center of Casing
				174.971	Top Manhole Rim, N. Edge stamped "X"
				174.807	Top Outer 6"SS Casing, N. Edge
				174.668	Top Pump Baseplate on Inner Casing, N.Edge
				174.958	Brass Survey Marker

Notes:
Unable to Measure Pump Baseplate Thickness

Equipment Used: Trimble GPS 5800 RTK
Trimble DiNi 0.7mm Level

Surveyor Statement:
I, Larry A. Henke, a Professional Land Surveyor registered in the State of Washington (Registration No. 38975), hereby certify that this report is based on a field survey performed in March, 2008 under my direct supervision, and that the data contained here is true and correct.

LARRY A. HENKE
STATE OF WASHINGTON
Mar 10 2008
38975
REGISTERED
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Table B-1. Sample Depths and HEIS #s for C5861.

Sample Depth (ft bgs)	Sample Method	HEIS #
145	Quart Grab	B1PN56
148	Quart Grab	B1PN57
149	Quart Grab	B1PN58
152	Quart Grab	B1PN59
155	Split-Spoon	B1PN60
157	Quart Grab	B1PN61
160	Quart Grab	B1PN62
163	Split-Spoon	B1PN63
165	Quart Grab	B1PN64
167.5	Quart Grab	B1PN65
170	Quart Grab	B1RRJ6
173.5	Split-Spoon	B1RRJ7
175	Quart Grab	B1RRJ8
174-176.5	Split-Spoon	B1PN45, B1PN47, B1PN48, B1PN49, B1PN53

Notes:

bgs= below ground surface

HEIS = *Hanford Environmental Information System* database

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