

APPENDIX C

**Existing Piezometer and Monitoring
Well Borehole Logs**



BOREHOLE LOG

WELL NO.

MW-1A

ARCADIS

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 1

PROJECT NUMBER: WA000712.0003.00002

WELL COMPLETION DETAILS:

PROJECT NAME: Reserve Silica Site

LOCATION: Ravensdale, WA

LOGGED BY: Brett Bardsley

DRILLING CO: Cascade Drilling Inc.

DRILLER: Andy Flagan

DRILLING METHOD: Hollow Stem Auger

DATE BEGUN: 07/11/05

DATE COMPLETED: 07/11/05

SURVEYED ELEVATION: 609.83 FT

DTW / (DATE): 35.43 (08/18/05)

SURFACE CASING GROUT TYPE: Concrete

SEAL TYPE: Bentonite chips

WELL SCREEN: 15', 2" PVC screen, 0.010" slots

SAND PACK: 2 X 12 grade sand

BACKFILL: Bentonite chips

TOTAL DEPTH DRILLED:

TYPES

DEPTH (FT BLS)

0-2

2-26

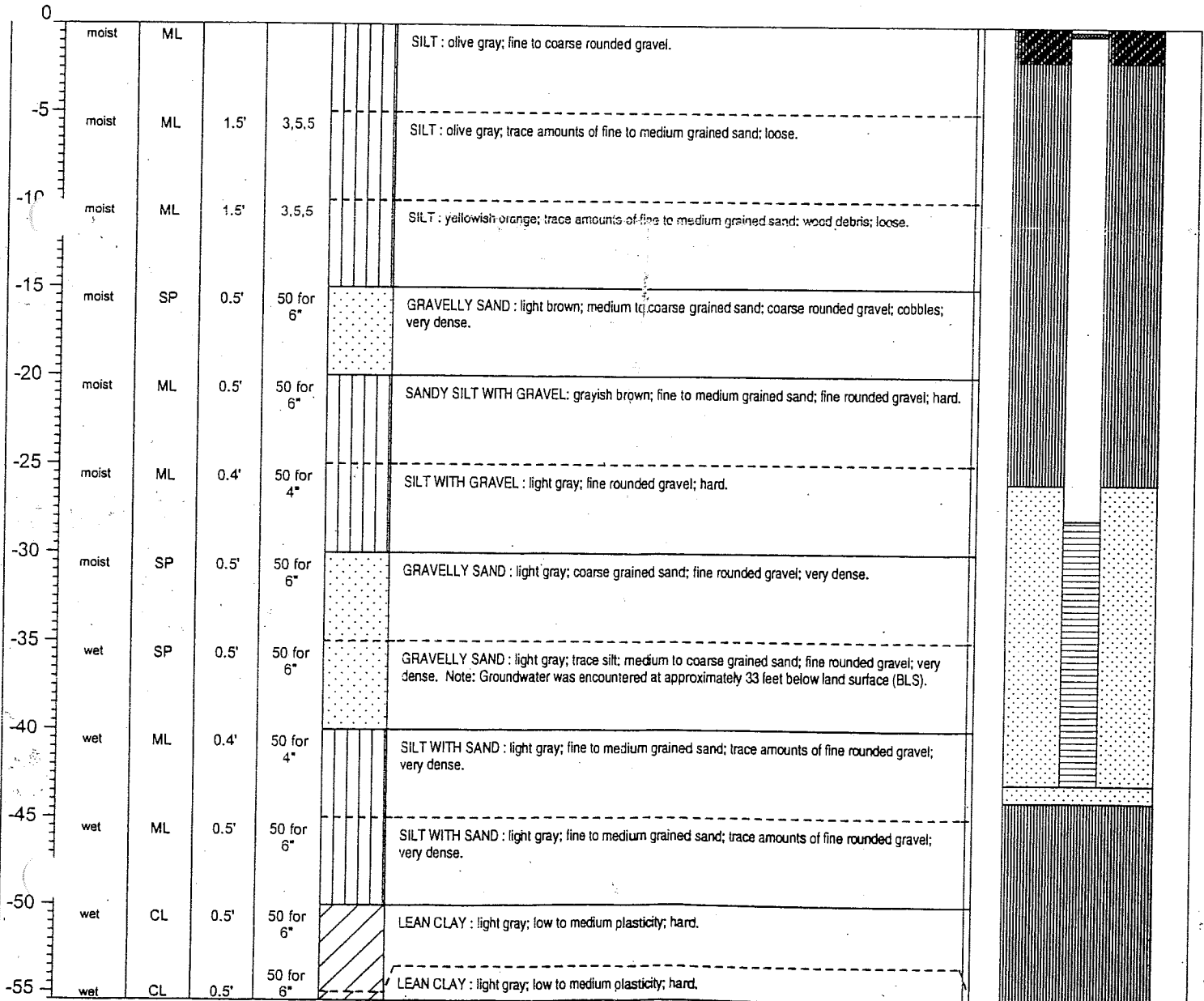
28-43

26-44

44-55.5

55.5

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BOREHOLE LOG

WELL NO.

MW-2A

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 1

PROJECT NUMBER: WA000712.0003.00002

WELL COMPLETION DETAILS:

PROJECT NAME: Reserve Silica Site

LOCATION: Ravensdale, WA

LOGGED BY: Brett Bardsley

DRILLING CO: Cascade Drilling Inc.

DRILLER: Andy Flagan

DRILLING METHOD: Hollow Stem Auger

DATE BEGUN: 07/12/05

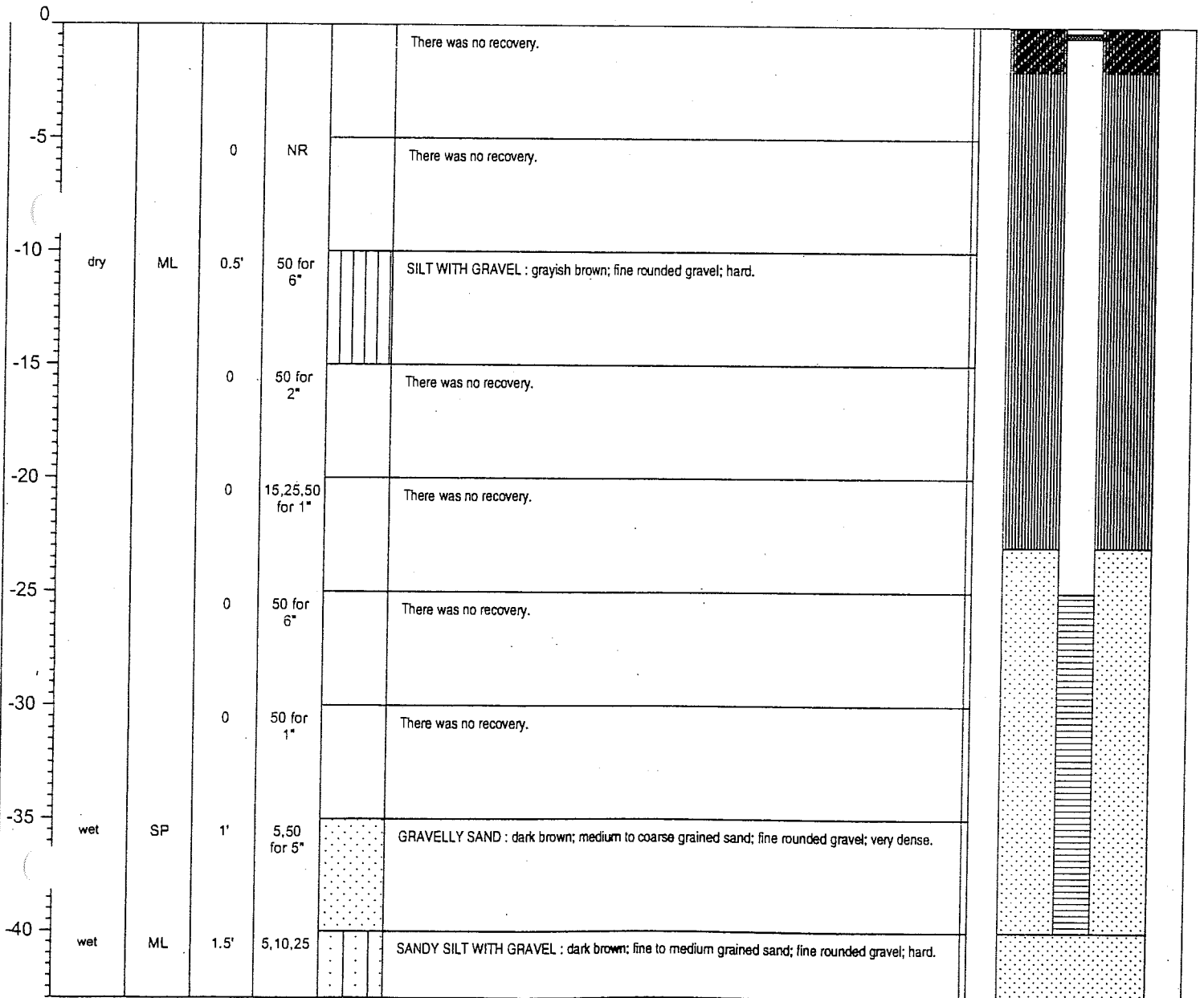
DATE COMPLETED: 07/15/05

SURVEYED ELEVATION: 603.61 FT

DTW / (DATE): 29.18 (08/18/05)

TYPES	DEPTH (FT BLS)
SURFACE CASING GROUT TYPE: Concrete	0-2
SEAL TYPE: Bentonite chips	2-23
WELL SCREEN: 15', 2" PVC screen, 0.010" slots	25-40
SAND PACK: 2 X 12 grade sand	23-40
TOTAL DEPTH DRILLED:	43

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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ARCADIS

BOREHOLE LOG

WELL NO.

MW-3A

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

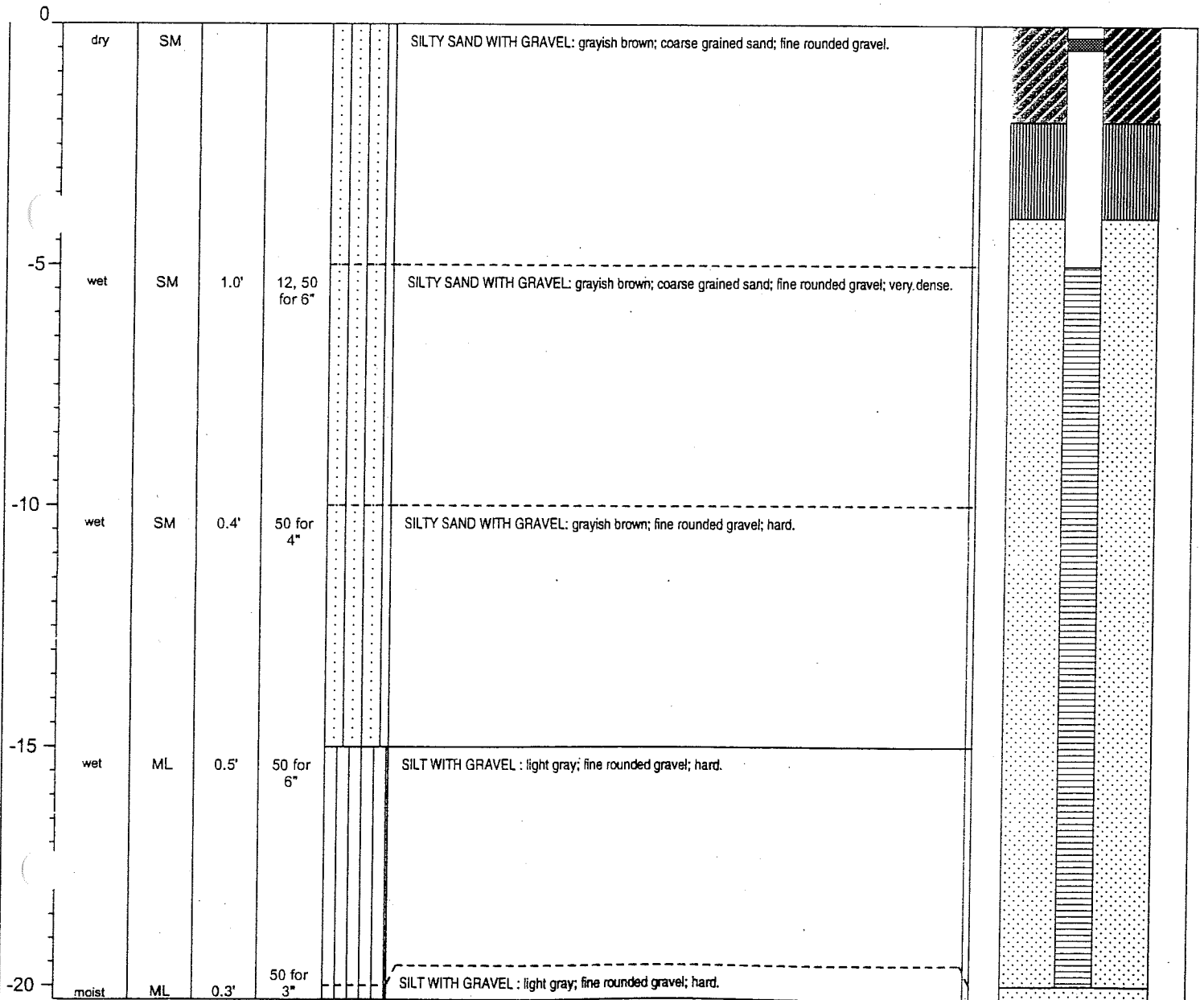
Page 1 of 1

PROJECT NUMBER: WA000712.0003.00002

WELL COMPLETION DETAILS:

		TYPES	DEPTH (FT BLS)
PROJECT NAME:	Reserve Silica Site		
LOCATION:	Ravensdale, WA		
LOGGED BY:	Brett Bardsley	SURFACE CASING GROUT TYPE: Concrete	0-2
DRILLING CO:	Cascade Drilling Inc.	SEAL TYPE: Bentonite chips	2-4
DRILLER:	Andy Flagan	WELL SCREEN: 15', 2" PVC screen, 0.010" slots	4-20
DRILLING METHOD:	Hollow Stem Auger	SAND PACK: 2 X 12 grade sand	5-20
DATE BEGUN:	07/12/05	TOTAL DEPTH DRILLED:	20.3
DATE COMPLETED:	07/12/05		
SURVEYED ELEVATION:	685.51 FT		
DTW / (DATE):	6.09 (07/15/05)		

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BOREHOLE LOG

WELL NO.

MW-4A

ARCADIS

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 1

PROJECT NUMBER: WA000712.0003.00002

WELL COMPLETION DETAILS:

PROJECT NAME: Reserve Silica Site

LOCATION: Ravensdale, WA

LOGGED BY: Brett Bardsley

DRILLING CO: Cascade Drilling Inc.

DRILLER: Andy Flagan

DRILLING METHOD: Hollow Stem Auger

DATE BEGUN: 07/13/05

DATE COMPLETED: 07/13/05

SURVEYED ELEVATION: 701.85 FT

DTW / (DATE): 4.60 (07/15/05)

SURFACE CASING GROUT TYPE: Concrete

SEAL TYPE: Bentonite chips

WELL SCREEN: 15', 2" PVC screen, 0.010" slots

SAND PACK: 2 X 12 grade sand

TOTAL DEPTH DRILLED:

TYPES

DEPTH (FT BLS)

0-2

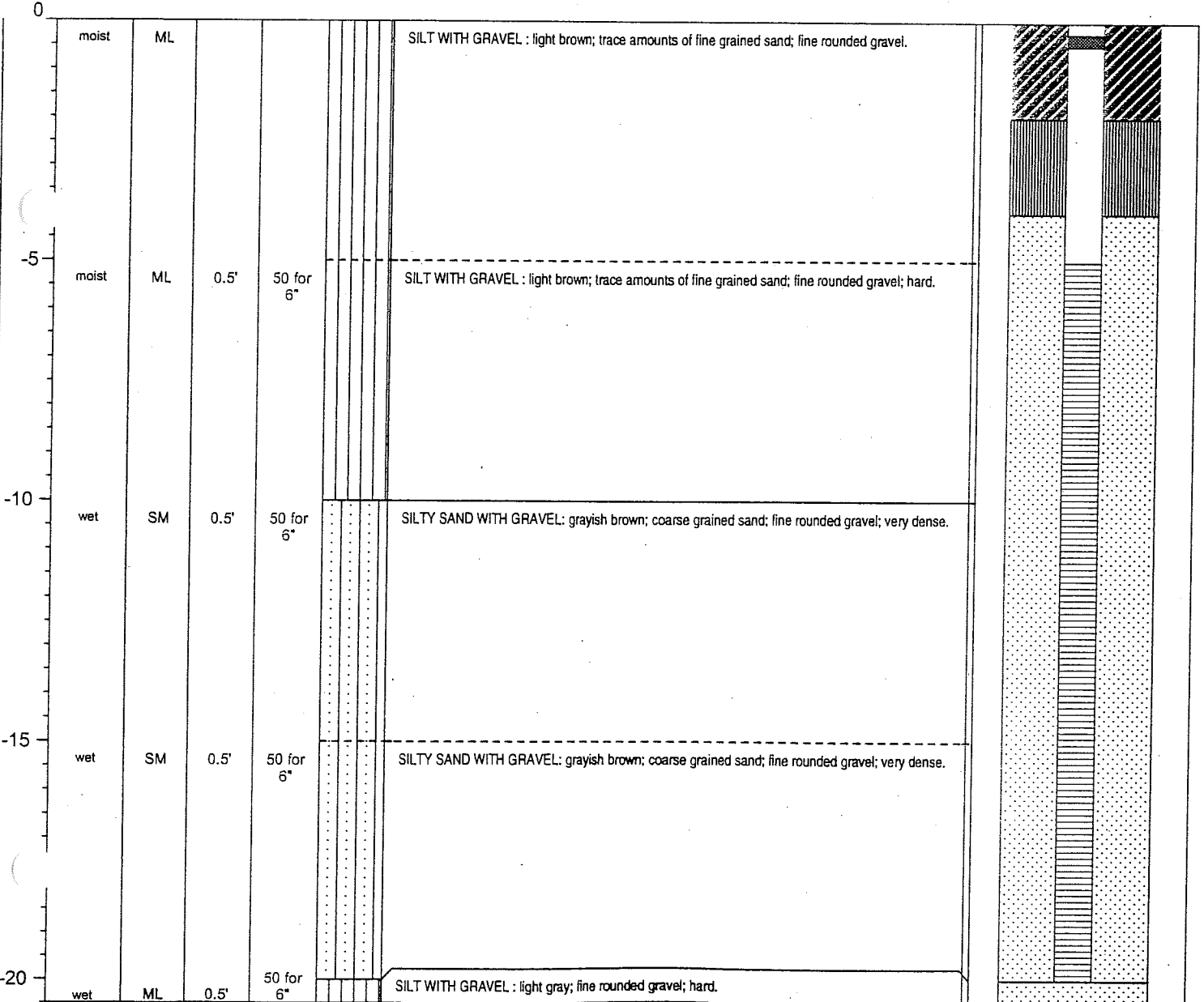
2-4

5-20

4-20

20.5

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BOREHOLE LOG

WELL NO.

MW-5A

ARCADIS

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

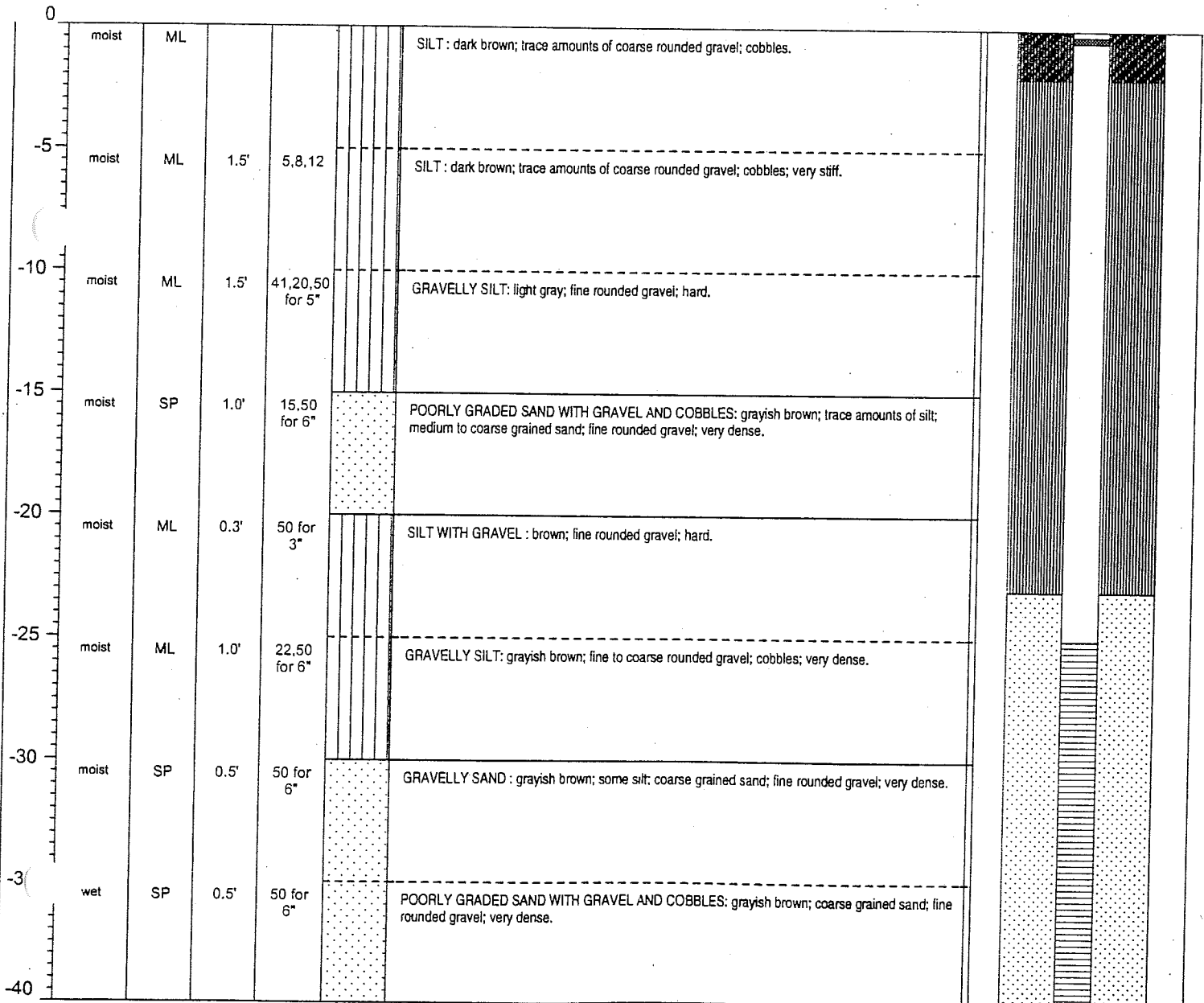
Page 1 of 1

PROJECT NUMBER: WA000712.0003.00002
 PROJECT NAME: Reserve Silica Site
 LOCATION: Ravensdale, WA
 LOGGED BY: Brett Bardsley
 DRILLING CO: Cascade Drilling Inc.
 DRILLER: Andy Flagan
 DRILLING METHOD: Hollow Stem Auger
 DATE BEGUN: 07/13/05
 DATE COMPLETED: 07/13/05
 SURVEYED ELEVATION: 607.61 FT
 DTW / (DATE): 33.33 (08/18/05)

WELL COMPLETION DETAILS:

TYPES	DEPTH (FT-BLS)
SURFACE CASING GROUT TYPE: Concrete	0-2
SEAL TYPE: Bentonite chips	2-23
WELL SCREEN: 15', 2" PVC screen, 0.010" slots	25-40
SAND PACK: 2 X 12 grade sand	23-40
TOTAL DEPTH DRILLED:	40

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BOREHOLE LOG

WELL NO.

MW-6A

ARCADIS

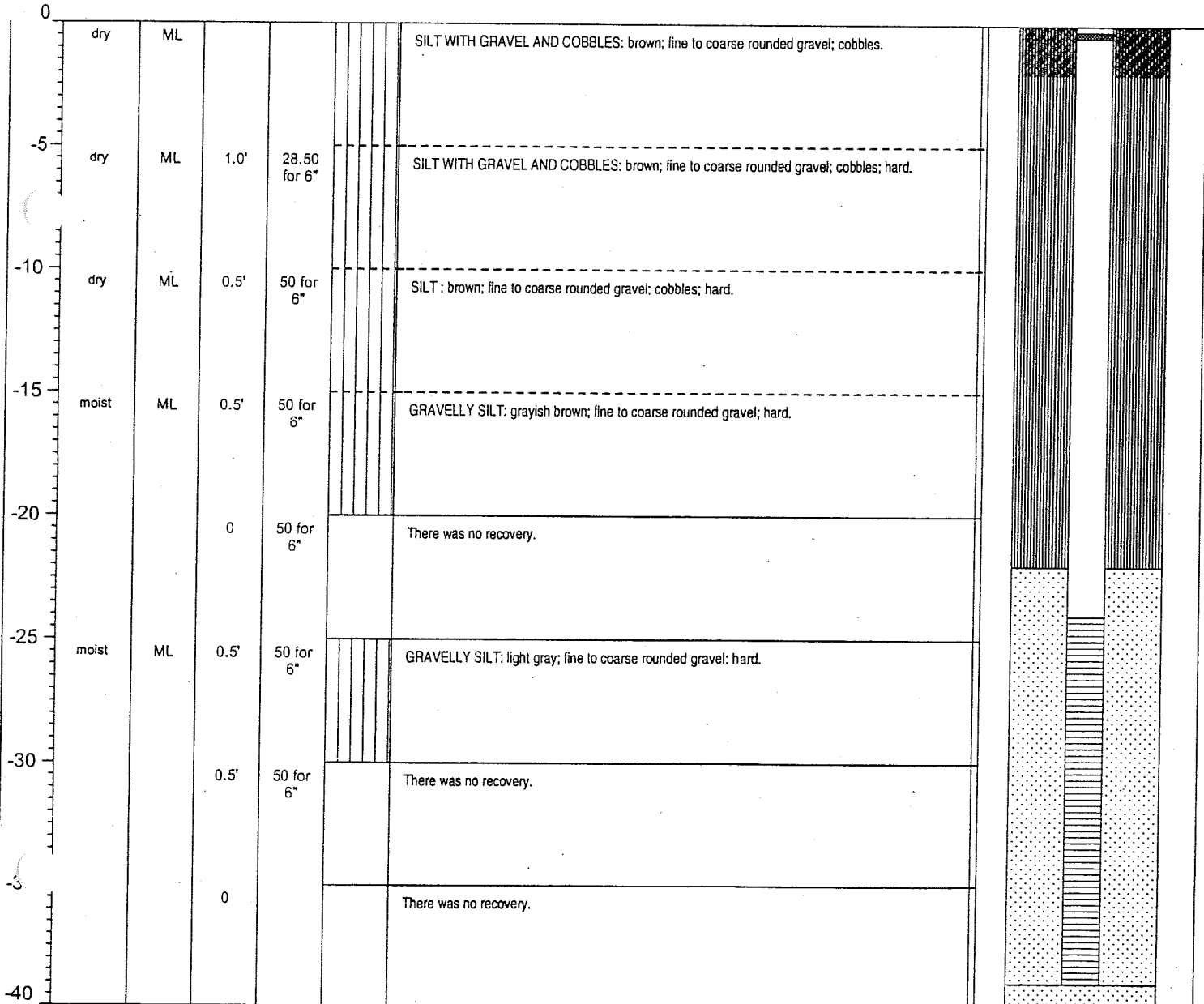
11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 1

PROJECT NUMBER:	WA000712.0003.00002	WELL COMPLETION DETAILS:	
PROJECT NAME:	Reserve Silica Site	TYPES	DEPTH (FT BLS)
PROJECT LOCATION:	Ravensdale, WA	SURFACE CASING GROUT TYPE: Concrete	0-2
LOGGED BY:	Brett Bardsley	SEAL TYPE: Bentonite chips	2-22
DRILLING CO:	Cascade Drilling Inc.	WELL SCREEN: 15', 2" PVC screen, 0.010" slots	24-39
DRILLER:	Andy Flagan	SAND PACK: 2 X 12 grade sand	22-39
DRILLING METHOD:	Hollow Stem Auger	TOTAL DEPTH DRILLED:	40.0
DATE BEGUN:	07/14/05		
DATE COMPLETED:	07/14/05		
SURVEYED ELEVATION:	605.35 FT		
DTW / (DATE):	30.89 (08/18/05)		

DEPTH	MOISTURE	U. S. C. S. CLASS	CORE RECOVERY	DENSITY BLOWS/6"	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.
MWB-1LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

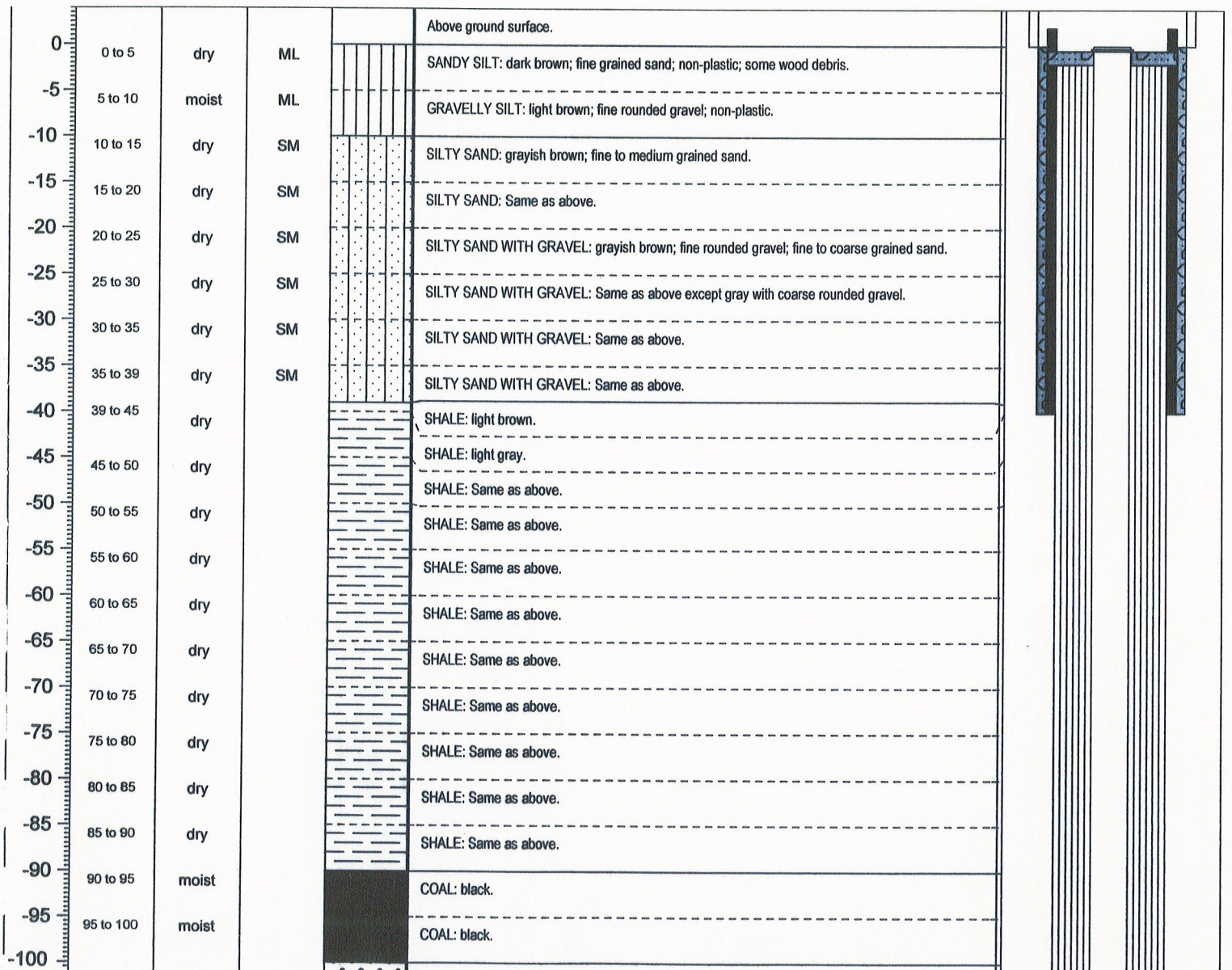
Page 1 of 2

PROJECT NUMBER: WA000712.0013.00001
 PROJECT NAME: Reserve Silica Site
 SITE LOCATION: Ravensdale, Washington
 LOGGED BY: Brett Bardsley, L.G.
 DRILLING CO: Cascade Drilling, Inc.
 DRILLER: Jarod Kump & Todd Mecham
 DRILLING METHOD: Air-Rotary
 DATE BEGUN: 12/04/06
 DATE COMPLETED: 12/05/06
 TOP OF PVC CASING ELEVATION (TOC): 701.08 feet
 DEPTH TO WATER BELOW TOC / (DATE): 26.51 (12/18/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)	
WELL CASING: 2" Schedule 40 PVC	0-115	
6 5/8" CONDUCTOR PIPE: Grouted with neat cement grout and 5% bentonite	0-40	
SURFACE CASING GROUT TYPE: Concrete	0-2	
SEAL TYPE: Bentonite chips	2-105	
	Bridge Sand	105-107
SAND PACK: 2 X 12 grade sand	107-135	
WELL SCREEN: 20', 2" PVC screen, 0.010" slots	115-135	
BACKFILL: 2 X 12 grade sand	135-155	
TOTAL DEPTH DRILLED:	155	

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-1LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

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PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 12/04/06

DATE COMPLETED: 12/05/06

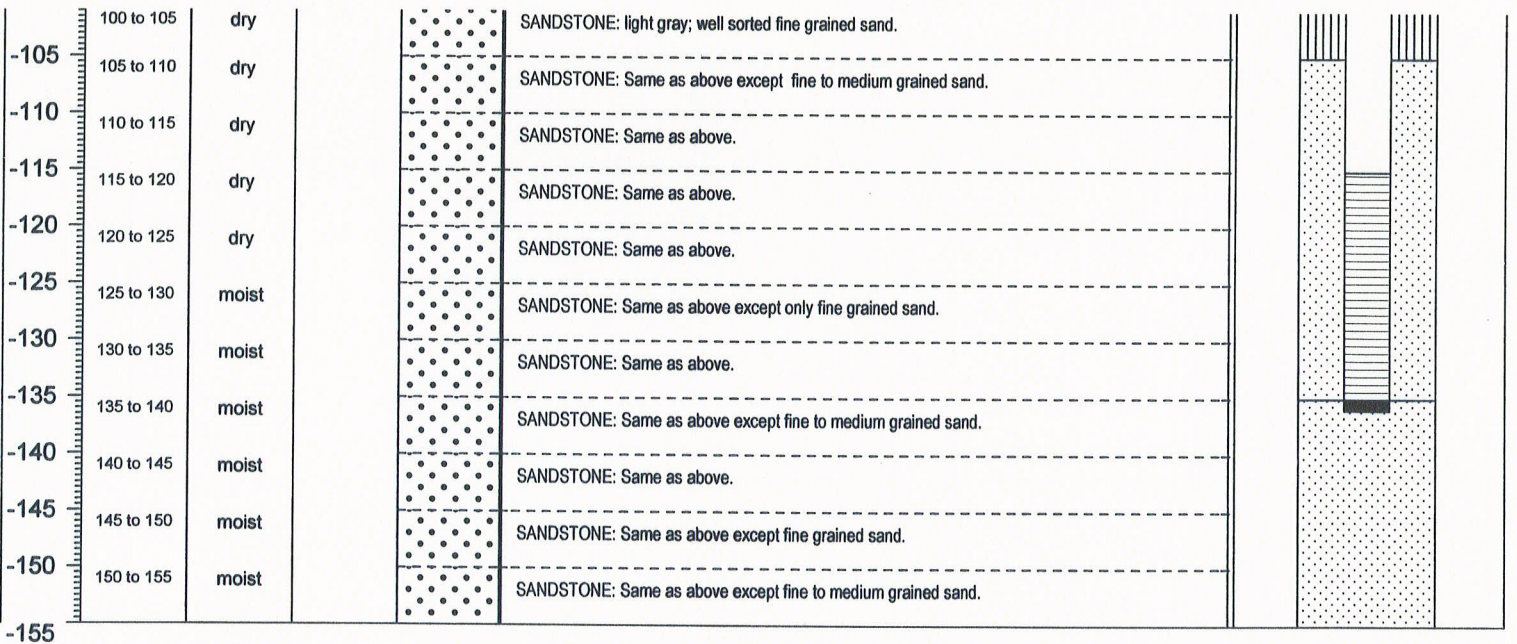
TOP OF PVC CASING ELEVATION (TOC): 701.08 feet

DEPTH TO WATER BELOW TOC / (DATE): 26.51 (12/18/06)

WELL COMPLETION DETAILS

		DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-115
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-40
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-105
	Bridge Sand	105-107
SAND PACK:	2 X 12 grade sand	107-135
WELL SCREEN:	20', 2" PVC screen, 0.010" slots	115-135
BACKFILL:	2 X 12 grade sand	135-155
TOTAL DEPTH DRILLED:		155

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-2LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/30/06

DATE COMPLETED: 12/05/06

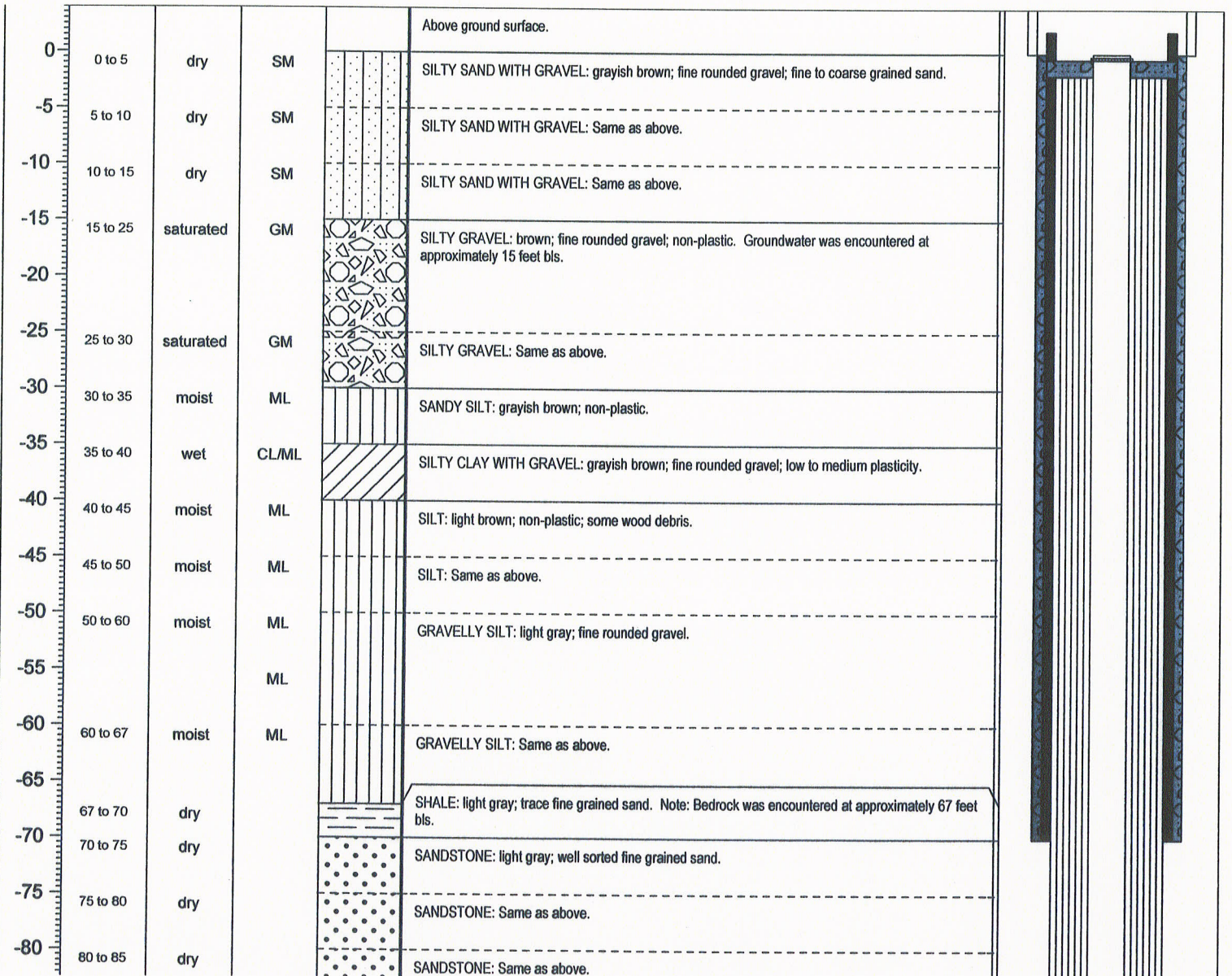
TOP OF PVC CASING ELEVATION (TOC): 738.06 feet

DEPTH TO WATER BELOW TOC / (DATE): 36.82 (12/18/06)

WELL COMPLETION DETAILS

	TYPES	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-110
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-70
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-103
	Bridge Sand	103-105
SAND PACK:	2 X 12 grade sand	105-125
WELL SCREEN:	15', 2" PVC screen, 0.010" slots	110-125
TOTAL DEPTH DRILLED:		125

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-2LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 2 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/30/06

DATE COMPLETED: 12/05/06

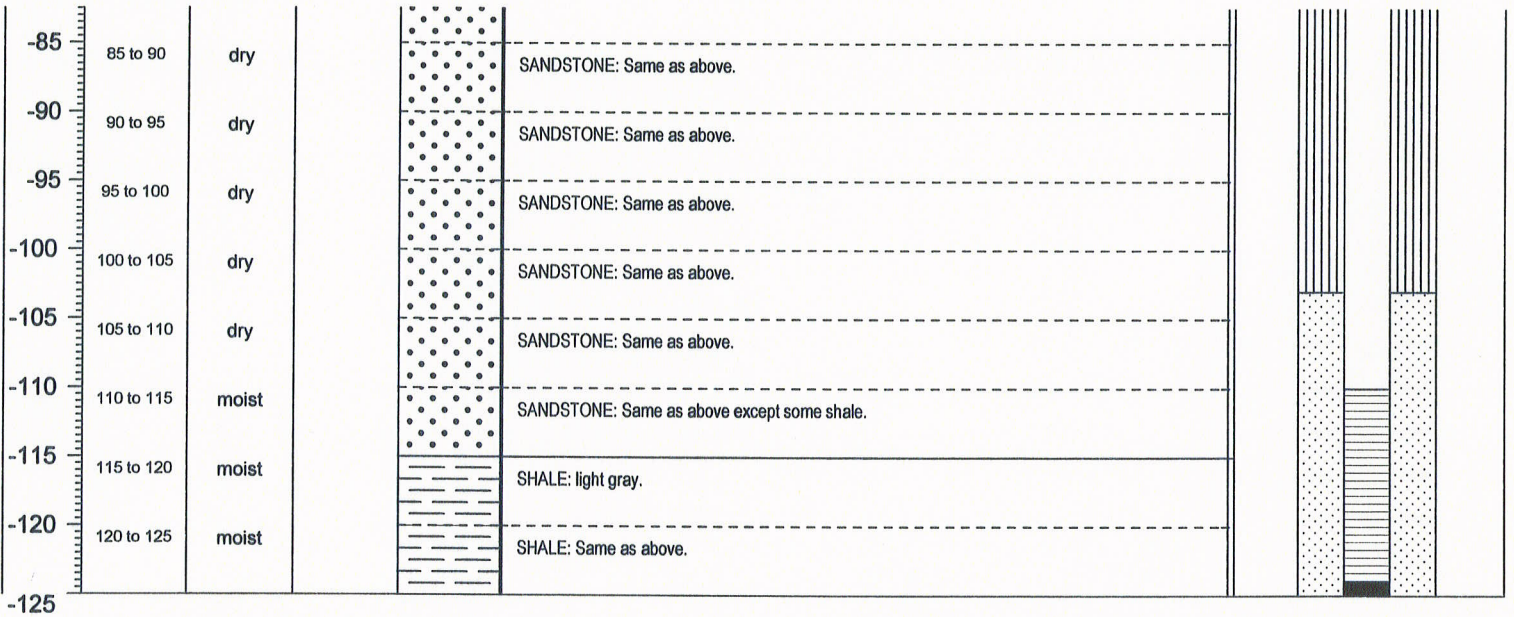
TOP OF PVC CASING ELEVATION (TOC): 738.06 feet

DEPTH TO WATER BELOW TOC / (DATE): 36.82 (12/18/06)

WELL COMPLETION DETAILS

	TYPES	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-110
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-70
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-103
	Bridge Sand	103-105
SAND PACK:	2 X 12 grade sand	105-125
WELL SCREEN:	15', 2" PVC screen, 0.010" slots	110-125
TOTAL DEPTH DRILLED:		125

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.
MWB-3LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/30/06

DATE COMPLETED: 12/05/06

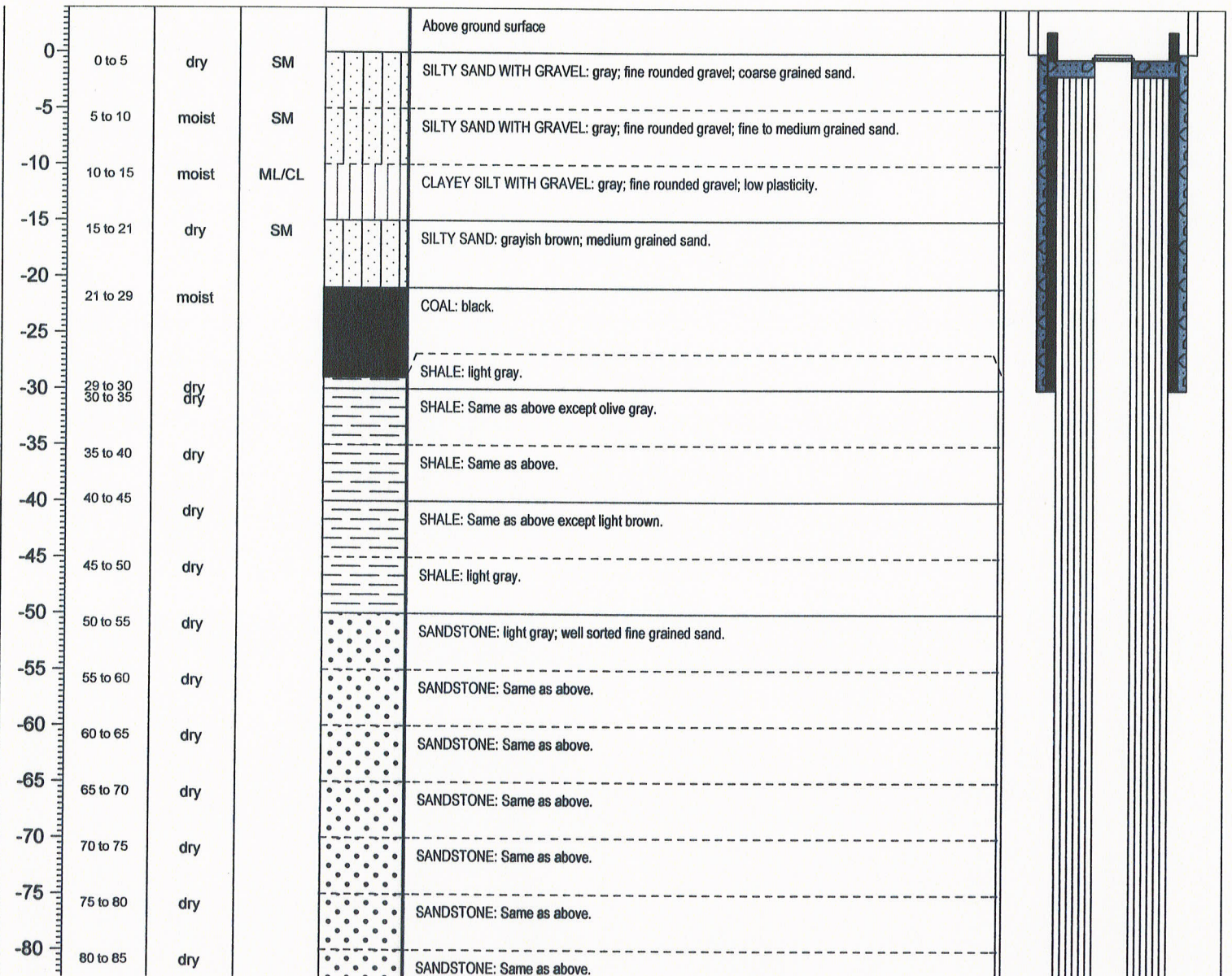
TOP OF PVC CASING ELEVATION (TOC): 740.59 ft

DEPTH TO WATER BELOW TOC / (DATE): 7.08 (12/18/06)

WELL COMPLETION DETAILS

	TYPES	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-125
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-30
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-115
	Bridge Sand	115-117
SAND PACK:	2 X 12 grade sand	117-145
WELL SCREEN:	20', 2" PVC screen, 0.010" slots	125-145
TOTAL DEPTH DRILLED:		145

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-3LDA

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 2 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/30/06

DATE COMPLETED: 12/05/06

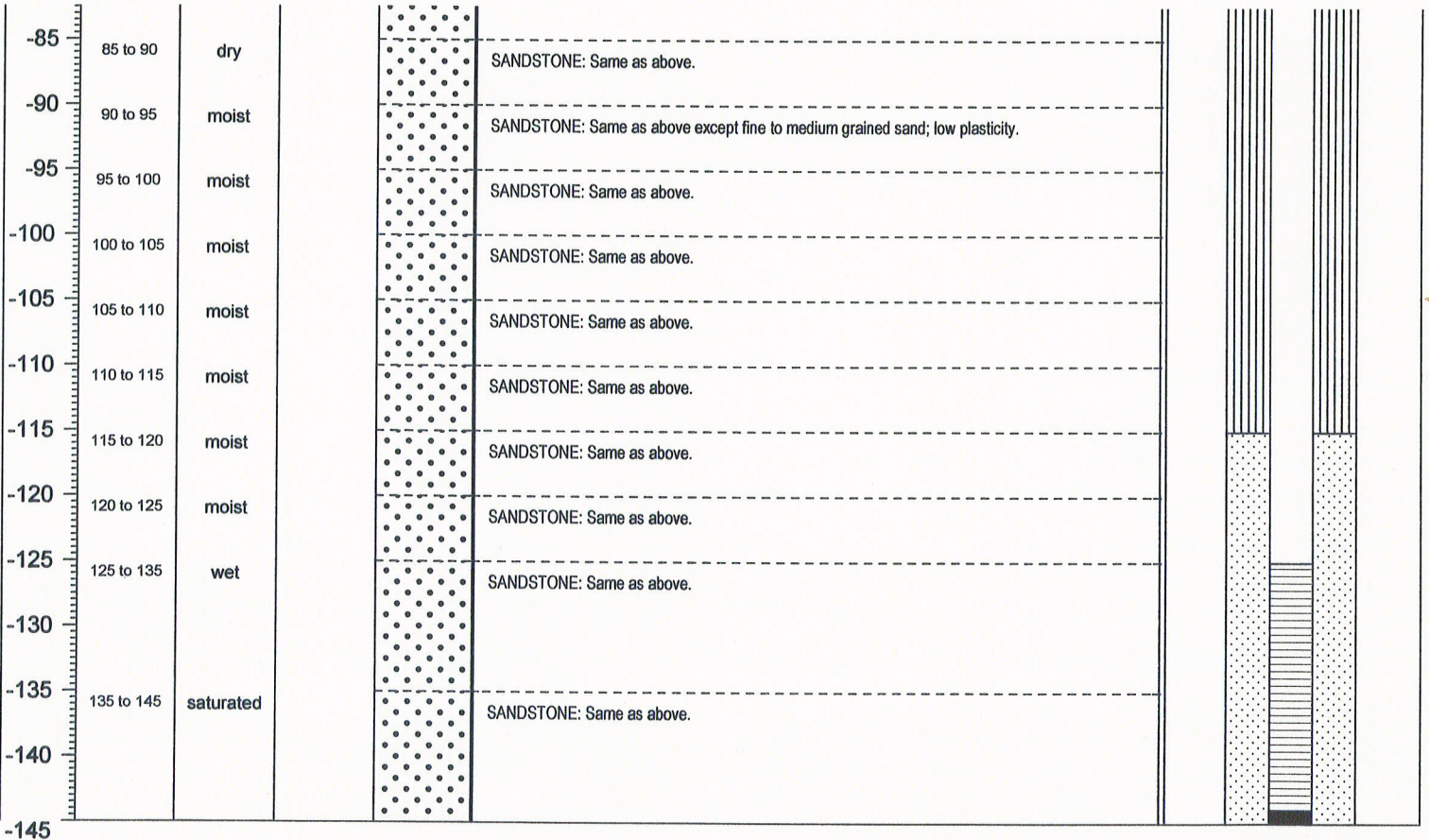
TOP OF PVC CASING ELEVATION (TOC): 740.59 ft

DEPTH TO WATER BELOW TOC / (DATE): 7.08 (12/18/06)

WELL COMPLETION DETAILS

	TYPES	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-125
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-30
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-115
	Bridge Sand	115-117
SAND PACK:	2 X 12 grade sand	117-145
WELL SCREEN:	20', 2" PVC screen, 0.010" slots	125-145
TOTAL DEPTH DRILLED:		145

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-1SDSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 2

PROJECT NUMBER: WA000712

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Wayne Harmon

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 12/06/02

DATE COMPLETED: 12/09/02

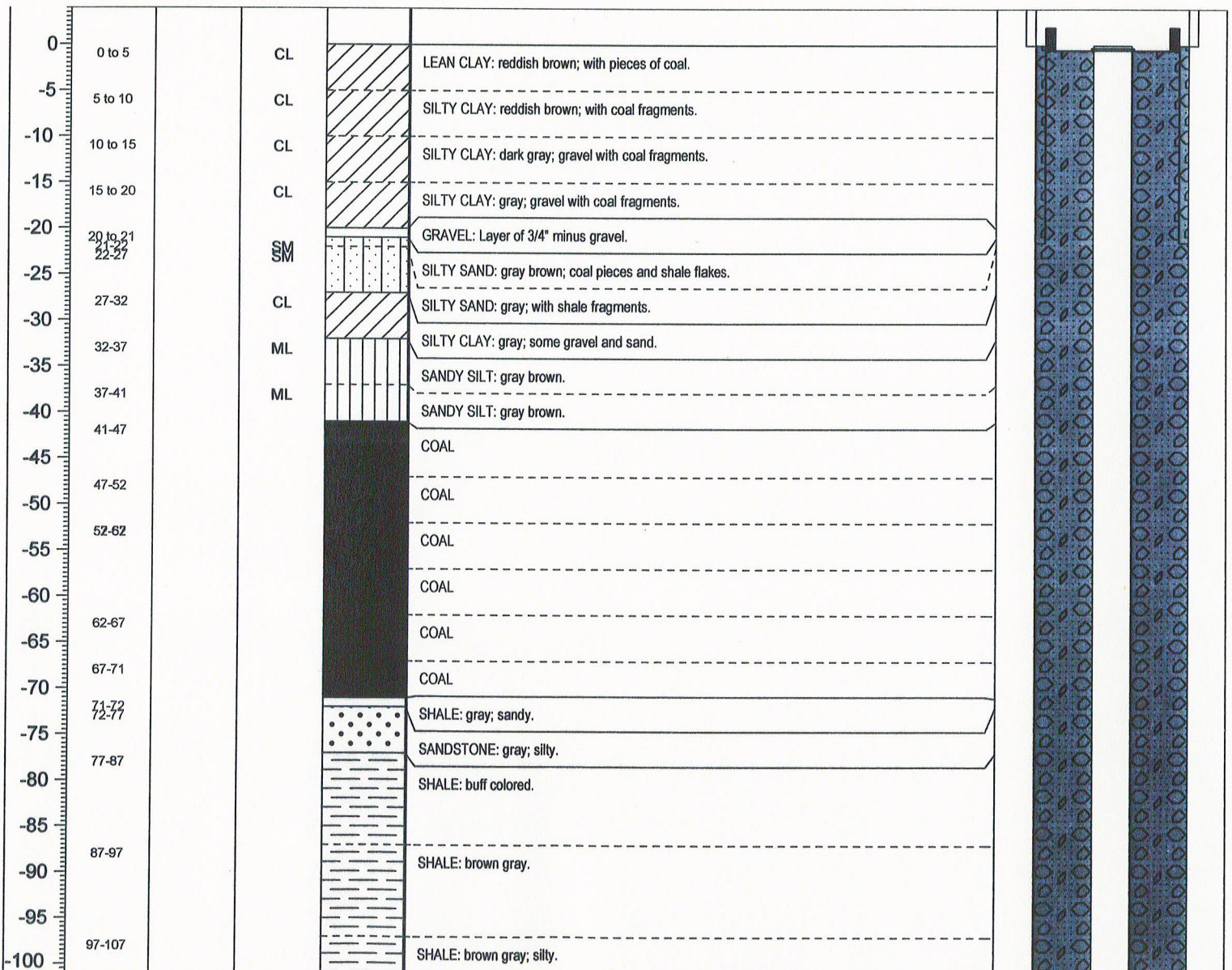
TOP OF PVC CASING ELEVATION (TOC): 932.69 feet

DEPTH TO WATER BELOW TOC / (DATE): 33.20 (12/28/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC 0-150
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite 0-21.5
SURFACE CASING GROUT TYPE:	Concrete 0-138
SEAL TYPE:	Bentonite chips 138-148
SAND PACK:	2 X 12 grade sand 148-160
WELL SCREEN:	10', 2" PVC screen, 0.010" slots 150-160
BACKFILL:	2 X 12 grade sand 160-165
TOTAL DEPTH DRILLED:	165

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-1SDSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

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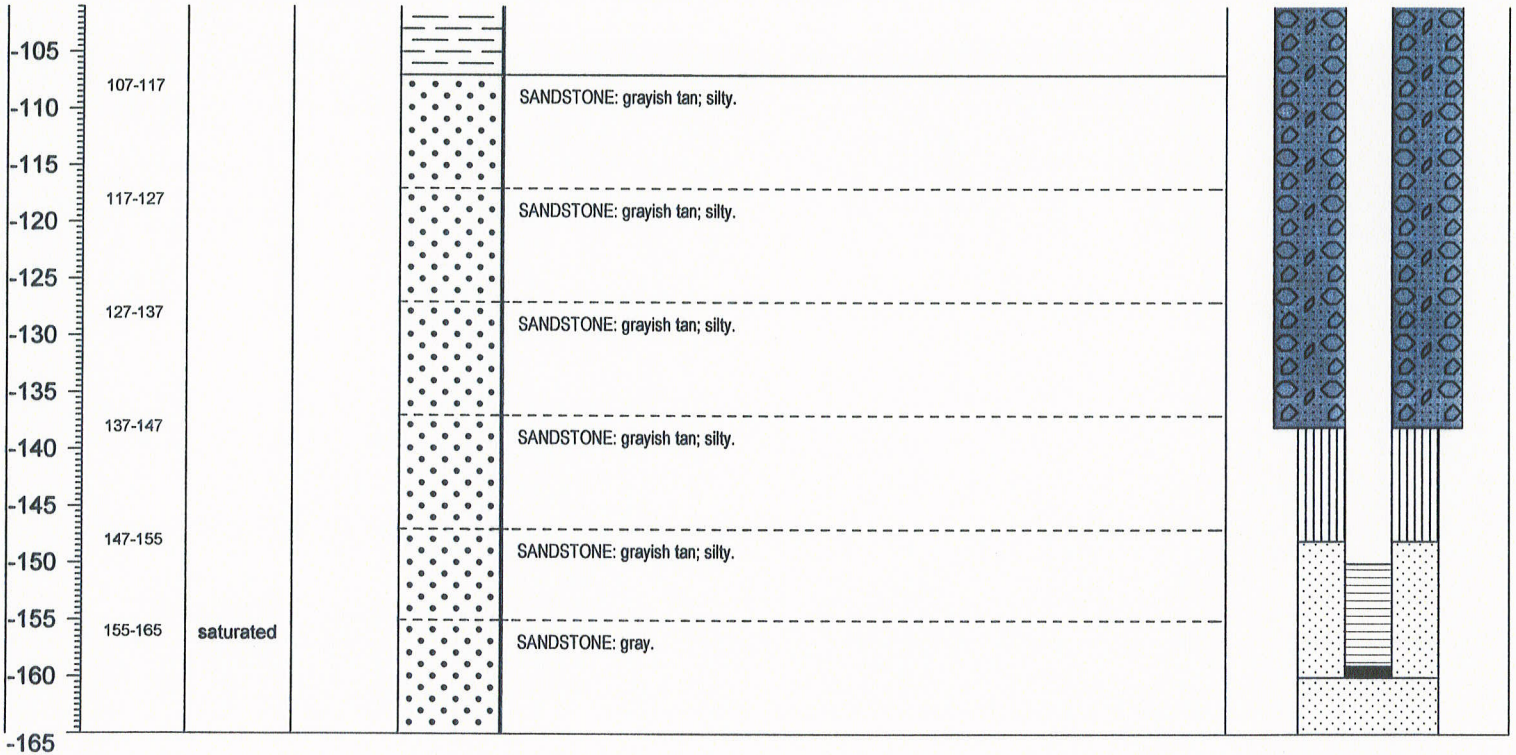
PROJECT NUMBER: WA000712

WELL COMPLETION DETAILS

PROJECT NAME: Reserve Silica Site
 SITE LOCATION: Ravensdale, Washington
 LOGGED BY: Wayne Harmon
 DRILLING CO: Cascade Drilling, Inc.
 DRILLER: Todd Mecham
 DRILLING METHOD: Air-Rotary
 DATE BEGUN: 12/06/02
 DATE COMPLETED: 12/09/02
 TOP OF PVC CASING ELEVATION (TOC): 932.69 feet
 DEPTH TO WATER BELOW TOC / (DATE): 33.20 (12/28/06)

	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC 0-150
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite 0-21.5
SURFACE CASING GROUT TYPE:	Concrete 0-138
SEAL TYPE:	Bentonite chips 138-148
SAND PACK:	2 X 12 grade sand 148-160
WELL SCREEN:	10', 2" PVC screen, 0.010" slots 150-160
BACKFILL:	2 X 12 grade sand 160-165
TOTAL DEPTH DRILLED:	165

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.
MWB-1DDSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 3

PROJECT NUMBER: WA000712

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Wayne Harmon

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 12/03/02

DATE COMPLETED: 12/09/02

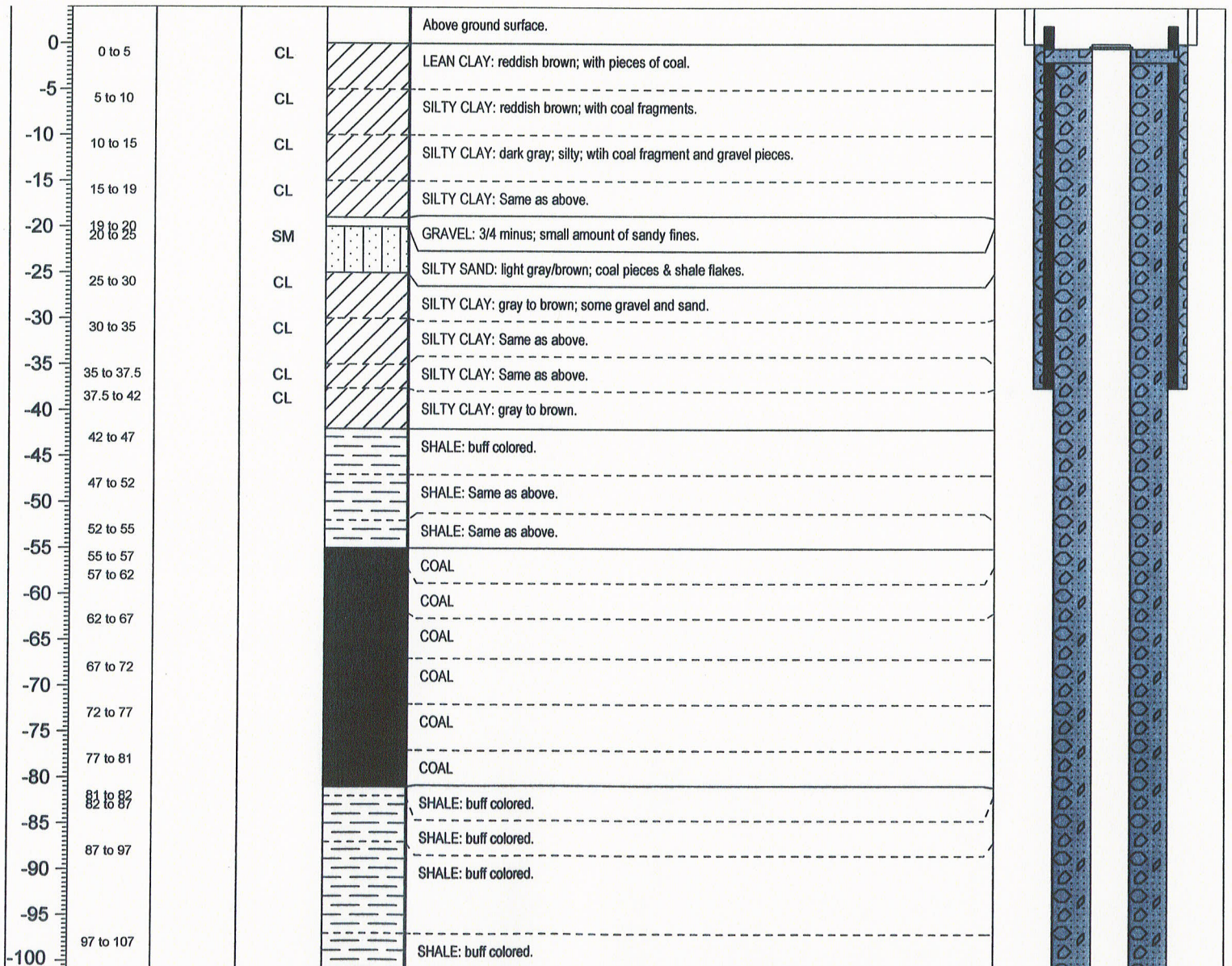
TOP OF PVC CASING ELEVATION (TOC): 931.77 FT

DEPTH TO WATER BELOW TOC / (DATE): 48.26 (12/28/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)
WELL CASING: 2" Schedule 40 PVC	0-255
6 5/8" CONDUCTOR PIPE: Grouted with neat cement grout and 5% bentonite	37.5
SURFACE CASING GROUT TYPE: Concrete	0-243
SEAL TYPE: Bentonite chips	243-253
SAND PACK: 2 X 12 grade sand	253-265
WELL SCREEN: 10', 2" PVC screen, 0.010" slots	255-265
BACKFILL: 2 X 12 grade sand	265-270
TOTAL DEPTH DRILLED:	270

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-1DDSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 2 of 3

PROJECT NUMBER: WA000712

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Wayne Harmon

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 12/03/02

DATE COMPLETED: 12/09/02

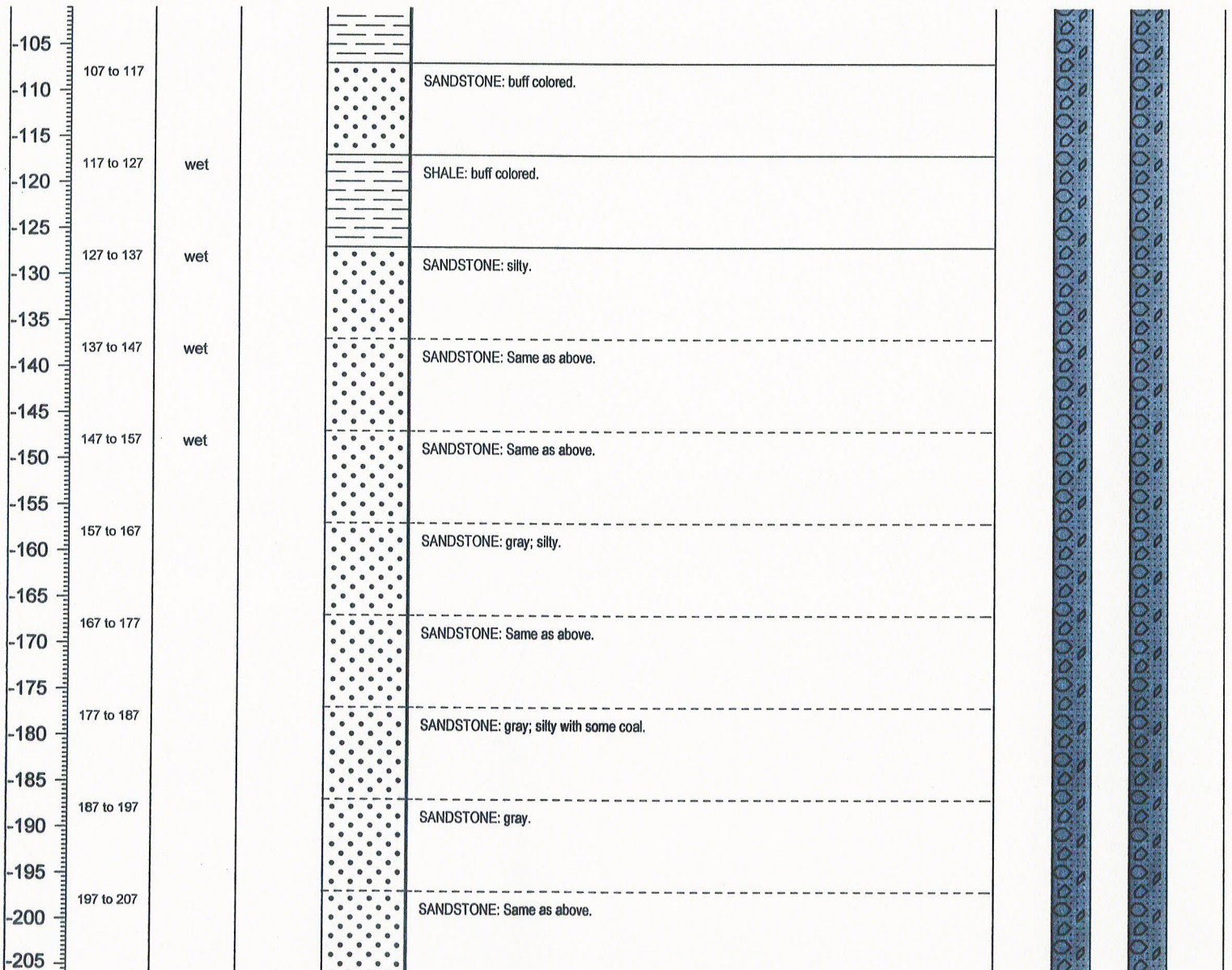
TOP OF PVC CASING ELEVATION (TOC): 931.77 FT

DEPTH TO WATER BELOW TOC / (DATE): 48.26 (12/28/06)

WELL COMPLETION DETAILS

		DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-255
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	37.5
SURFACE CASING GROUT TYPE:	Concrete	0-243
SEAL TYPE:	Bentonite chips	243-253
SAND PACK:	2 X 12 grade sand	253-265
WELL SCREEN:	10', 2" PVC screen, 0.010" slots	255-265
BACKFILL:	2 X 12 grade sand	265-270
TOTAL DEPTH DRILLED:		270

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-1DDSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 3 of 3

PROJECT NUMBER: WA000712

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Wayne Harmon

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 12/03/02

DATE COMPLETED: 12/09/02

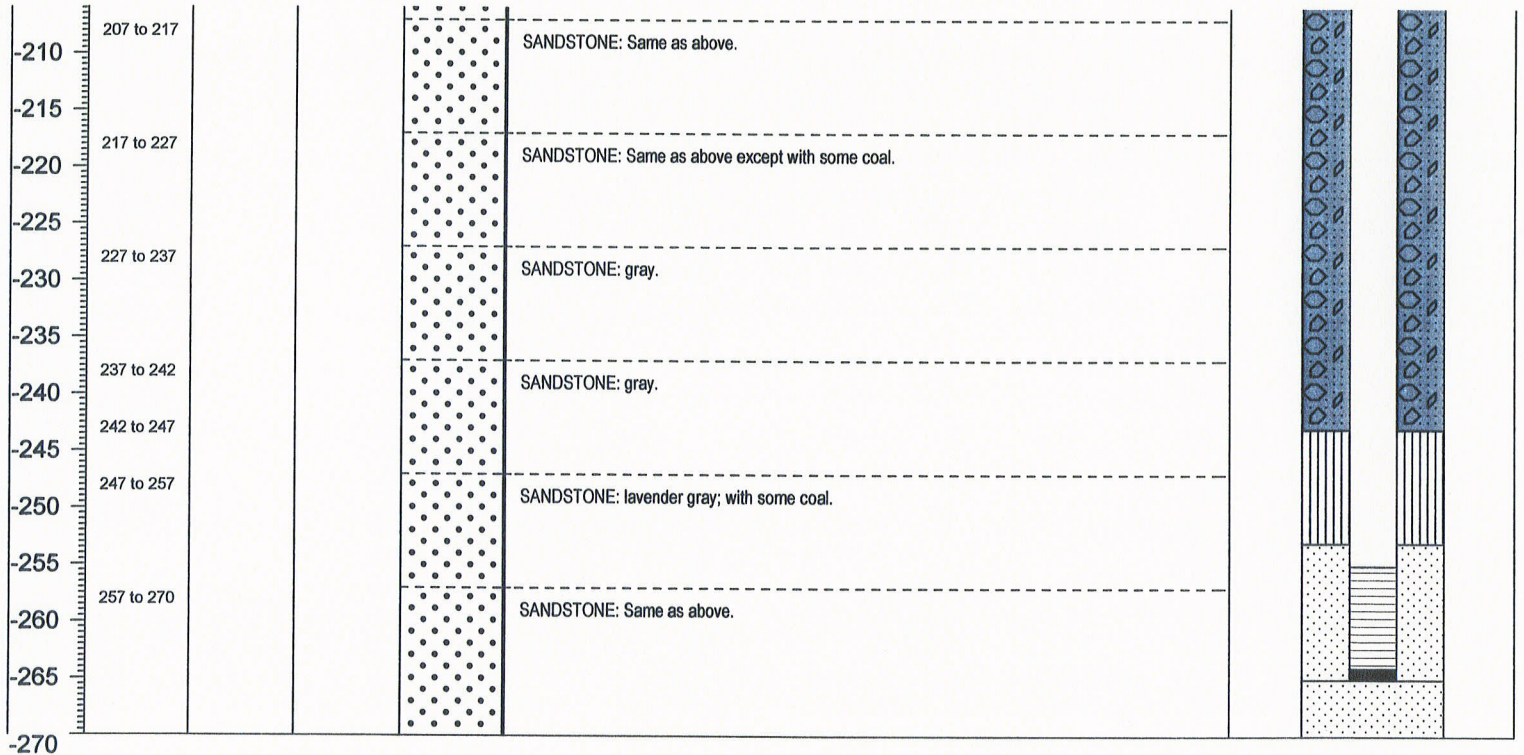
TOP OF PVC CASING ELEVATION (TOC): 931.77 FT

DEPTH TO WATER BELOW TOC / (DATE): 48.26 (12/28/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)
WELL CASING: 2" Schedule 40 PVC	0-255
6 5/8" CONDUCTOR PIPE: Grouted with neat cement grout and 5% bentonite	37.5
SURFACE CASING GROUT TYPE: Concrete	0-243
SEAL TYPE: Bentonite chips	243-253
SAND PACK: 2 X 12 grade sand	253-265
WELL SCREEN: 10', 2" PVC screen, 0.010" slots	255-265
BACKFILL: 2 X 12 grade sand	265-270
TOTAL DEPTH DRILLED:	270

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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Test Well 2
 INDUSTRIAL MINERAL PRODUCTS
 RAVENSDALE

MWB-2DSP

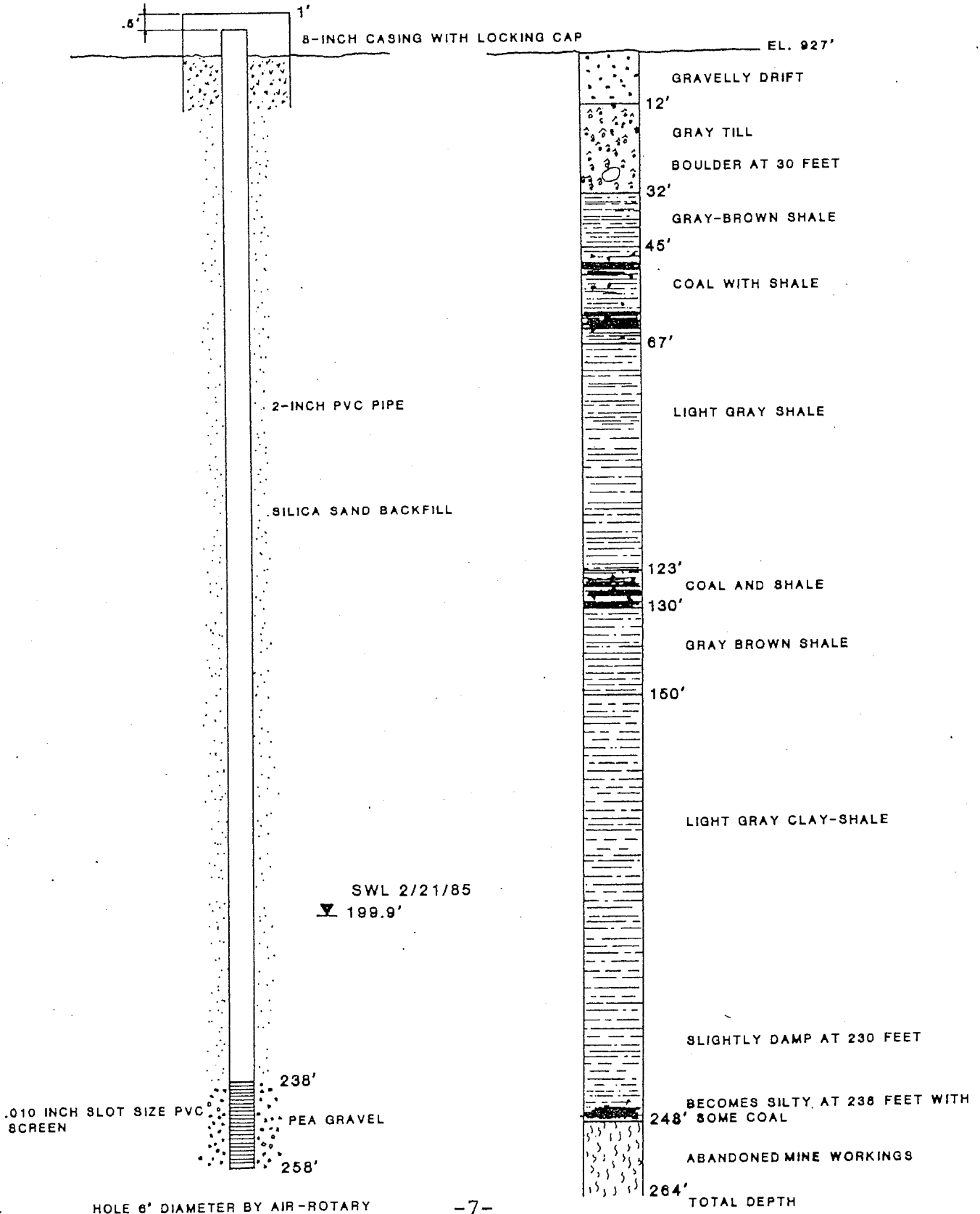
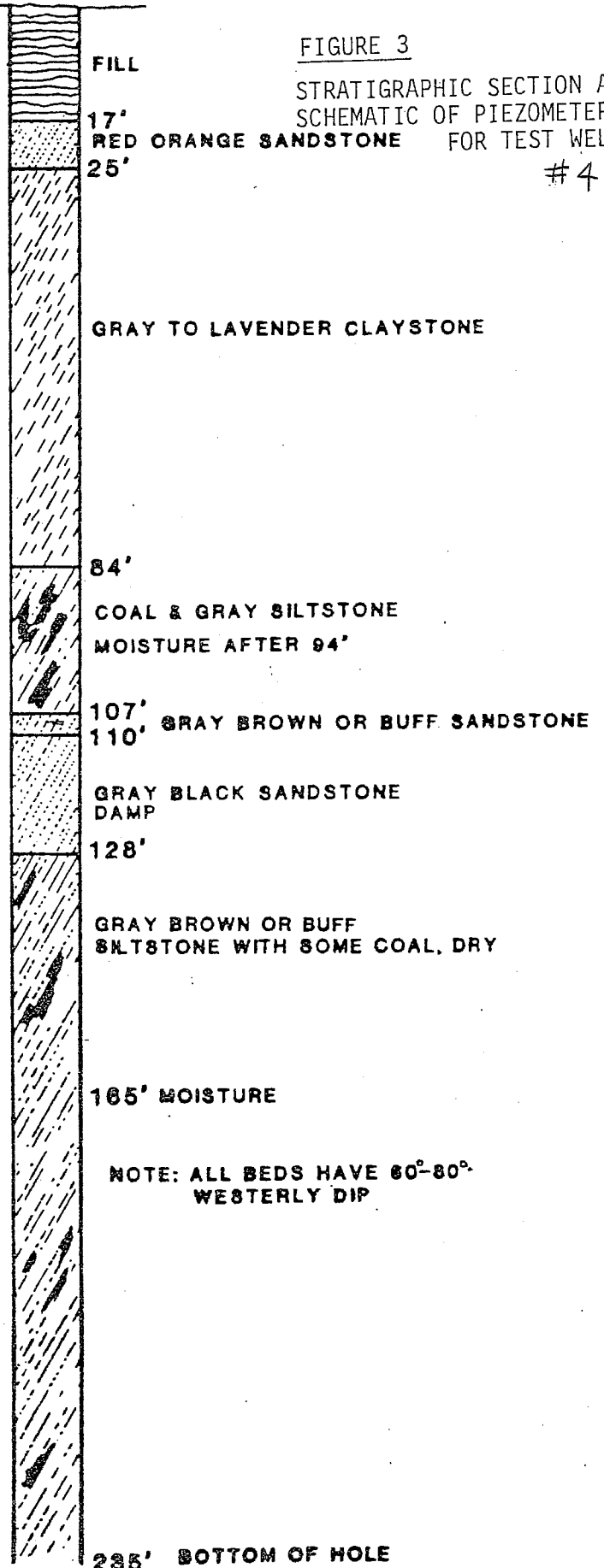
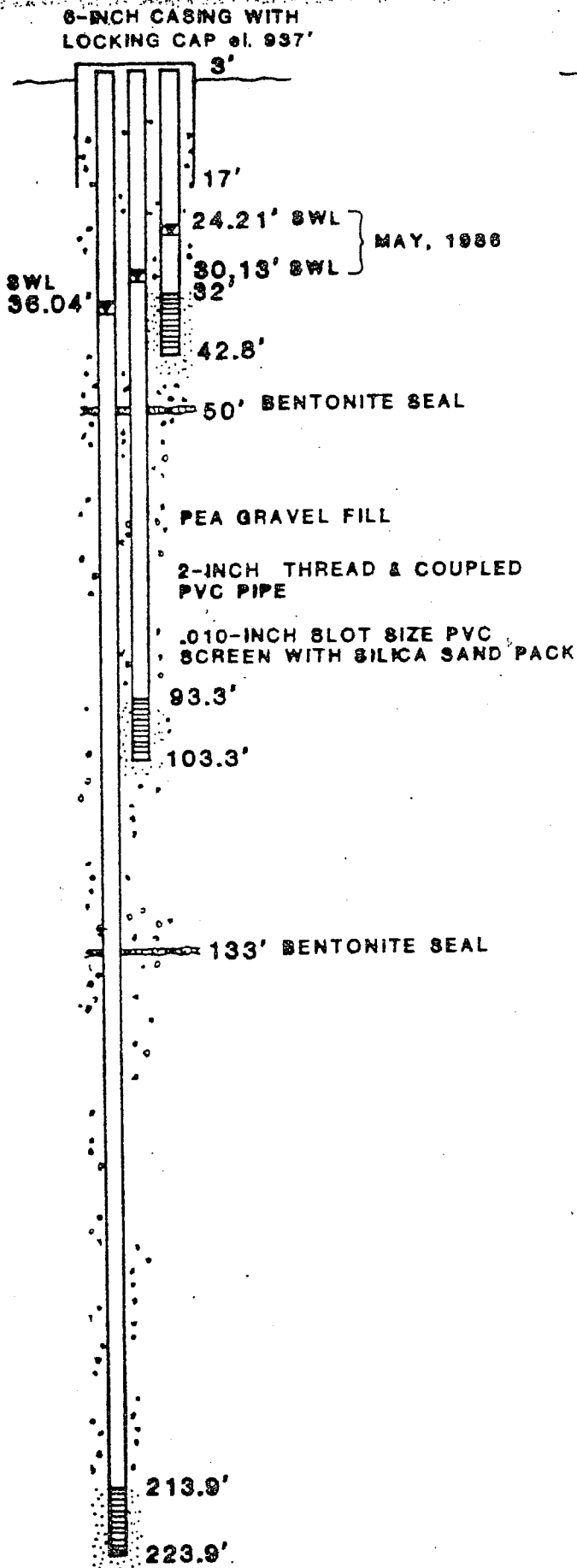


FIGURE 3

STRATIGRAPHIC SECTION AND SCHEMATIC OF PIEZOMETER P FOR TEST WELL #4

#4



6-INCH DIAMETER HOLE BY AIR ROTARY

235' BOTTOM OF HOLE



BORING / WELL COMPLETION LOG

WELL NO.

MWB-5DSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 1

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/27/06

DATE COMPLETED: 11/29/06

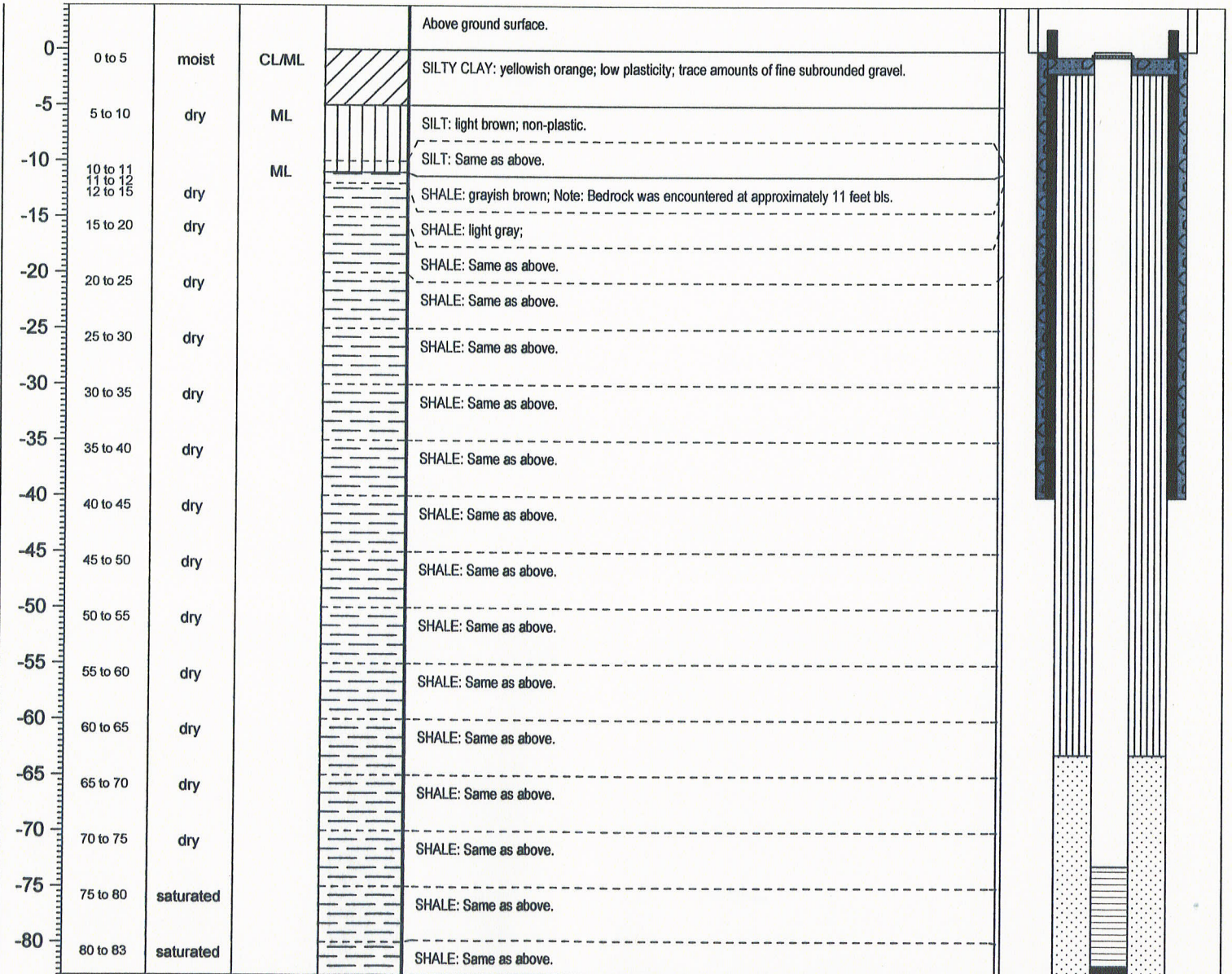
TOP OF PVC CASING ELEVATION (TOC): 931.45

DEPTH TO WATER BELOW TOC / (DATE): 20.56 (12/28/06)

WELL COMPLETION DETAILS

	TYPES	DEPTH (FT BLS)
WELL CASING:	2" Schedule 40 PVC	0-73
6 5/8" CONDUCTOR PIPE:	Grouted with neat cement grout and 5% bentonite	0-20
SURFACE CASING GROUT TYPE:	Concrete	0-2
SEAL TYPE:	Bentonite chips	2-61
	Bridge Sand	61-63
SAND PACK:	2 X 12 grade sand	63-83
WELL SCREEN:	10', 2" PVC screen, 0.010" slots	73-83
TOTAL DEPTH DRILLED:		83

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-6DSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 1 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/28/06

DATE COMPLETED: 11/30/06

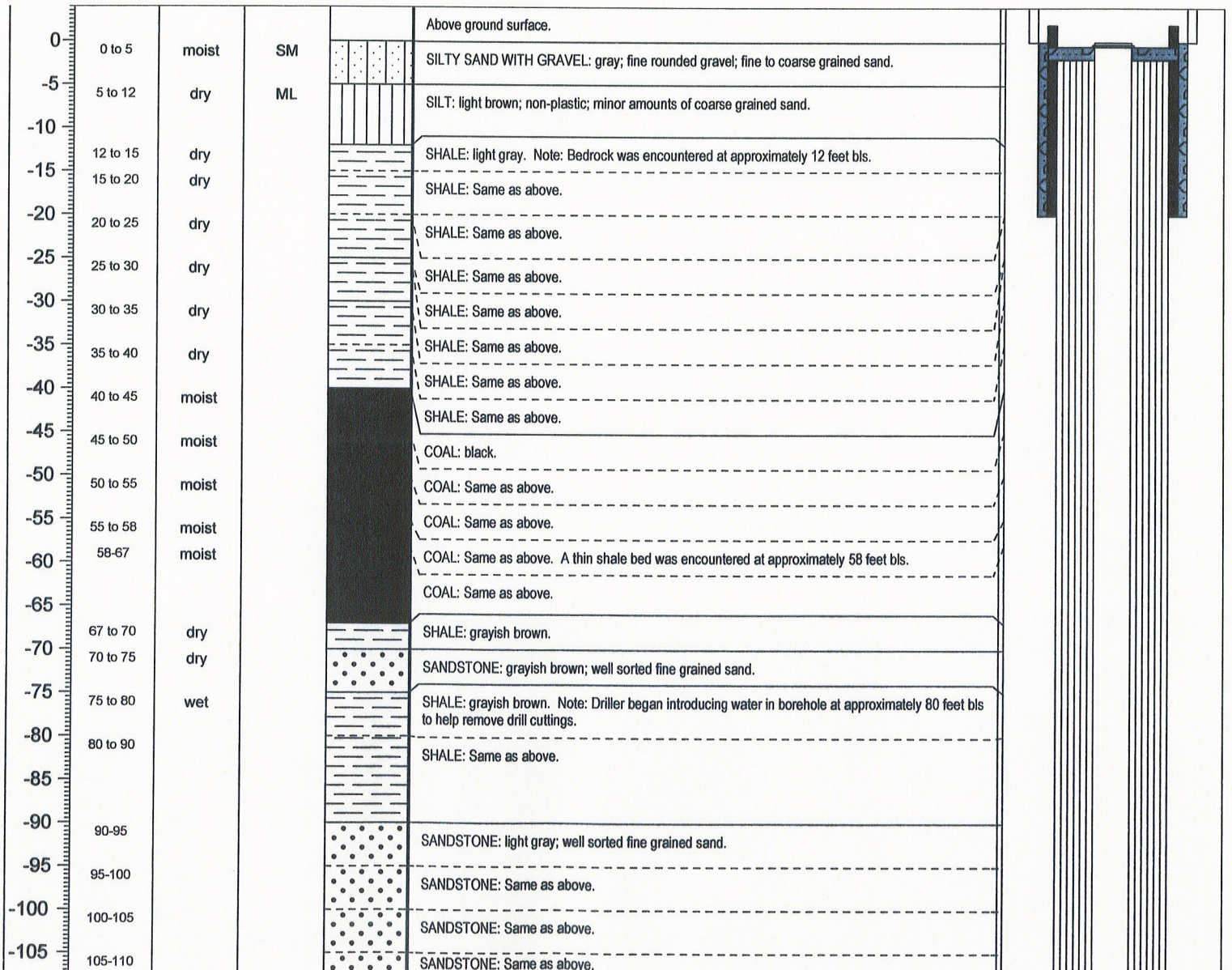
TOP OF PVC CASING ELEVATION (TOC): 902.35 feet

DEPTH TO WATER BELOW TOC / (DATE): 8.13 (12/28/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)	
WELL CASING: 2" Schedule 40 PVC	0-120	
6 5/8" CONDUCTOR PIPE: Grouted with neat cement grout and 5% bentonite	0-20	
SURFACE CASING GROUT TYPE: Concrete	0-2	
SEAL TYPE: Bentonite chips	2-108	
	Bridge Sand	108-110
SAND PACK: 2 X 12 grade sand	110-195	
WELL SCREEN: 75', 2" PVC screen, 0.010" slots	120-195	
BACKFILL: 2 X 12 grade sand	195-199	
TOTAL DEPTH DRILLED:	199	

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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BORING / WELL COMPLETION LOG

WELL NO.

MWB-6DSP

11411 NE 124th Street, Suite 270, Kirkland, WA 98034

Tel: 425 821-2100 Fax: 425 821-2111

Page 2 of 2

PROJECT NUMBER: WA000712.0013.00001

PROJECT NAME: Reserve Silica Site

SITE LOCATION: Ravensdale, Washington

LOGGED BY: Brett Bardsley, L.G.

DRILLING CO: Cascade Drilling, Inc.

DRILLER: Jarod Kump & Todd Mecham

DRILLING METHOD: Air-Rotary

DATE BEGUN: 11/28/06

DATE COMPLETED: 11/30/06

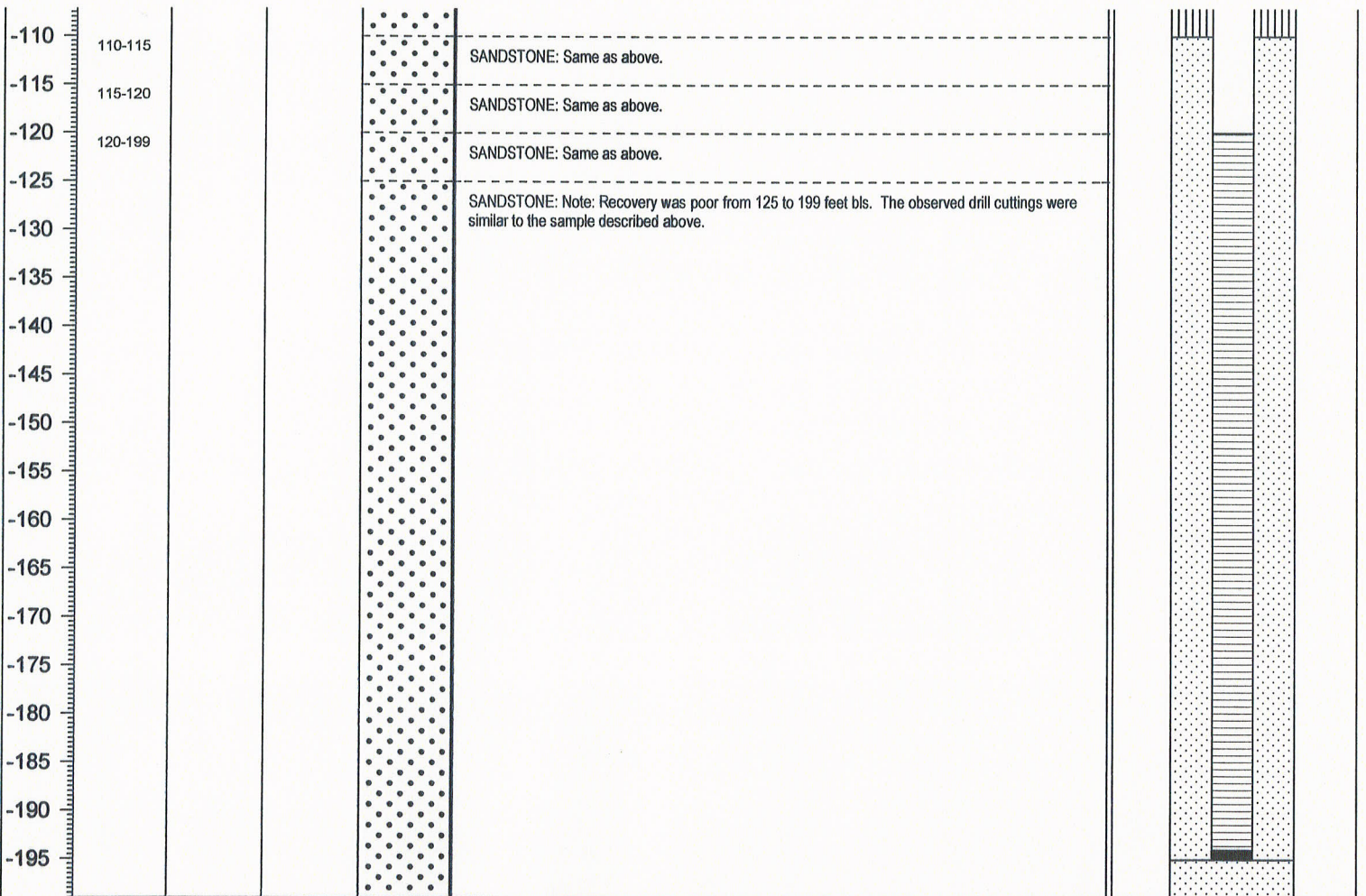
TOP OF PVC CASING ELEVATION (TOC): 902.35 feet

DEPTH TO WATER BELOW TOC / (DATE): 8.13 (12/28/06)

WELL COMPLETION DETAILS

	DEPTH (FT BLS)	
WELL CASING: 2" Schedule 40 PVC	0-120	
6 5/8" CONDUCTOR PIPE: Grouted with neat cement grout and 5% bentonite	0-20	
SURFACE CASING GROUT TYPE: Concrete	0-2	
SEAL TYPE: Bentonite chips	2-108	
	Bridge Sand	108-110
SAND PACK: 2 X 12 grade sand	110-195	
WELL SCREEN: 75', 2" PVC screen, 0.010" slots	120-195	
BACKFILL: 2 X 12 grade sand	195-199	
TOTAL DEPTH DRILLED:	199	

DEPTH	SAMPLE INTERVAL	MOISTURE CONTENT	U.S.C.S. CLASS	LITHOLOGY	DESCRIPTION	WELL INSTALLATION
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CLIENT Holcim
PROJECT NUMBER 152030402
DATE STARTED 11/20/20 **COMPLETED** 11/20/20
DRILLING CONTRACTOR Cascade Drilling
DRILLING METHOD Sonic
LOGGED BY T. Haskins, LG **CHECKED BY** G. Zimmerman
NOTES Ecology Well ID: BLZ447

PROJECT NAME Reserve Silica Reclamation Site
PROJECT LOCATION Ravensdale, WA
GROUND ELEVATION Not Surveyed **HOLE SIZE** 6-inch
GROUND WATER LEVELS:
 ▽ **DURING DRILLING** 40.0 feet bgs
 ▼ **AFTER DRILLING** 31.09 feet bgs

DEPTH (ft)	REMARKS	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
2			Topsoil and Clay Cap	
5			Light gray CLAY, stiff, high plasticity, moist [MINE WASTE SOIL]	Flush-mount monument and concrete surface seal
10			Dry	
14			Light gray powder/SILT, dry [Cement Kiln Dust (CKD)]	3/8" hydrated bentonite chips
20			Moist	
25			Wet, perched groundwater	
30			▼ Clayey SILT/CKD, moist	12/20 Colorado silica sand filter pack around 0.010" slotted PVC screen from 40 to 50 ft bgs
35	pH 13 when soil mixed with water		CKD with gravel, moist	
40			▽ Gray SILT with gravel, moist [CKD]	
42			Mottled brown and gray, GRAVEL with silt and sand, dry to moist [MINE WASTE GRAVEL]	
45	pH 13 when soil mixed with water		Red and brown, SILT and gravel, oxidized, moist to wet [MINE WASTE SILT and CKD]	End cap
50			Dry to moist	
51			Mottled gray, SILT and clay, with sand and gravel, moist [MINE WASTE SILT and CKD]	
55			Glass fragments/paper present	3/8" hydrated bentonite chips
60	pH 13 when soil mixed with water		Color changes to dull gray, cobbles present	
61			Highly weathered SANDSTONE, white, grades to orange at 61.5ft, oxidized, thinly laminated, dry to moist [SANDSTONE BEDROCK]	
65	pH neutral when soil mixed with water			
70				

Bottom of borehole at 70.0 feet.

GENERAL BH / TP / WELL RAVENSDALE-P-14.GPJ GINT STD A4.GDT 12/15/20

**APPENDIX A
EXPLORATION LOGS**

**APPENDIX A-1
PROBING LOGS**

RECORD OF BOREHOLE P-1 PROBE


SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILL DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,874.52 E: 127,628.32

ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS				
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)							
											W _p	W _L	W _p		W _L			
0	Hydraulic Direct Push 2.25-inch Rod Diameter	0.0 - 18.0 Loose to compact, medium brown to medium gray, mottled, heterogeneous, mix of silty fine to medium SAND and fine to medium sandy SILT, little to some organics (rootlets), damp to moist (SM) (FILL-MINE SPOILS)	SM		727.0 18.0	Run 1	GRAB											
		1.0 - 1.5 Loose to compact, light gray, mottled, imported cement kiln dust, damp (FILL)																
		Sample S-1 collected at 1 ft bgs																
5		5.0 - 10.0 No recovery in Run 2																
		10 - 15 Poor recovery in Run 3																
		10 - 15 Scattered wood fibers observed																
		Sample S-2 collected at 10 ft bgs																
10		15 - 18 Little fine gravel observed																
		18.0 - 22.0 Compact to dense, medium to olive brown, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT, little to some fine gravel, little organics (rootlets), moist (SM/CL-ML) (FILL-MINE SPOILS)	SM/ CL-ML															
15																		
20																		

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

Log continued on next page

RECORD OF BOREHOLE P-1 PROBE

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILLING DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,874.52 E: 127,628.32

ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						20	40	60		80
20		Sample S-3 collected at 18 ft bgs 18.0 - 22.0 Compact to dense, medium to olive brown, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT, little to some fine gravel, little organics (rootlets), moist (SM/CL-ML) (FILL-MINE SPOILS) (Continued)	SM/ CL-ML		723.0 22.0	Run 4	GRAB			2.0 2.0					Soil density estimated from probe action
20.0		Becomes dense to very dense Sample S-4 collected at 21 ft bgs No groundwater encountered at time of probing Refusal in mine spoils Boring completed at 22.0 ft.													
25															
30															
35															
40															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-2 PROBE

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILLING DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,977.30 E: 127,350.47

ELEVATION: 775
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _p		W _L
0	Hydraulic Direct Push 2.25-inch Rod Diameter	0.0 - 3.5 Compact to dense, orange-brown, mottled, heterogeneous, silty fine to medium SAND, little fine gravel, little organics (rootlets), trace fine-grained coal fragments, damp to moist (SM) (FILL-MINE SPOILS)	SM												
		Sample S-1 collected at 3 ft bgs 3.5 - 20.0 Compact to dense, medium brown to medium gray, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT with little to some fine to medium sand, little fine gravel, little organics (rootlets), trace fine-grained coal fragments, damp to moist (SM/CL-ML) (FILL-MINE SPOILS)		771.5		Run 1	GRAB				3.5	5.0			
5		5.0 - 10.0 Scattered wood fragments observed Sample S-2 collected at 6 ft bgs		3.5		Run 2	GRAB				2.0	5.0			
10		Sample S-3 collected at 13 ft bgs 13.0 1-inch thick pocket of wood fragments observed	SM/ CL-ML			Run 3	GRAB				4.5	5.0			
15	Sample S-4 collected at 16 ft bgs 16.0 - 19.0 2 to 4-inch zones of imported cement kiln dust interlayered between orange-brown fine to medium sand				Run 4	GRAB				3.8	5.0				
20		Log continued on next page		755.0											

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-2 PROBE

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILLING DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,977.30 E: 127,350.47

ELEVATION: 775
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L	W _u		W _s
20		20.0 - 22.0 Compact to dense, light orange-brown, mottled, heterogeneous, fine SAND, damp (SP) (FILL-MINE SPOILS) Sample S-5 collected at 21 ft bgs No groundwater encountered at time of probing Refusal in mine spoils Boring completed at 22.0 ft.	SP		20.0	Run 5	GRAB			$\frac{3.0}{2.0}$					Soil density estimated from probe action

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-5 PROBE

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILL DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,014.40 E: 126,648.65

ELEVATION: 765
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
											W _p	W _L	W _p		W _L	
0	Hydraulic Direct Push 2.25-Inch Rod Diameter	0.0 - 2.0 Compact to dense, medium brown, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT, little to some organics (rootlets), scattered pockets of fine-grained coal fragments, damp (CL) (FILL-LOW PERMEABILITY SOIL COVER)	CL		763.0											
		Sample S-1 collected at 1 ft bgs		2.0												
		2.0 - 12.0 Compact to dense, tan to medium brown to medium gray, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT, little angular gravel clasts, little organics (rootlets), scattered pockets of fine-grained coal fragments, damp (SM/CL-ML) (FILL-MINE SPOILS)	SM/ CL-ML			Run 1	GRAB				1.4 5.0					
5		Sample S-2 collected at 7.5 ft bgs									5.0 5.0					
10	Sample S-3 collected at 10 ft bgs															
		12.0 - 16.0 Dense to very dense, light gray, mottled, heterogeneous, cement kiln dust, damp (FILL-IMPORTED CEMENT KILN DUST)	N/A		753.0											
		Sample S-4 collected at 15 ft bgs			12.0	Run 3	GRAB			5.0 5.0						
15		No groundwater encountered at time of probing			749.0	Run 4	GRAB			1.0 1.0						
		Refusal in cement kiln dust Boring completed at 16.0 ft.			16.0											

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

Soil density estimated from probe action

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-6 PROBE

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: Fill east of LDA Cover

DRILLING METHOD: Hydraulic Direct Push
 DRILLING DATE: 9/27/10
 DRILL RIG: Geoprobe 7720DT

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,164.94 E: 127,156.60

ELEVATION: 820
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS				
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)							
					DEPTH (ft)						W _p	W _L	W _u		W _s			
0	Hydraulic Direct Push 2.25-inch Rod Diameter	0.0 - 28.0 Loose to very dense, medium brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little fine gravel, little organics (rootlets, wood fragments), damp to moist, organic odor (SM) (FILL-MINE SPOILS) Sample S-1 collected at 2 ft bgs	SM															
5		6.0 - 7.0 Orange-brown, silty sand to silt with scattered fine-grained coal fragments observed Sample S-2 collected at 6 ft bgs																
10		Sample S-3 collected at 12 ft bgs																
15		Sample S-4 collected at 15 ft bgs Sample S-5 collected at 16 ft bgs 16.0 - 18.0 Light to medium gray, fine to medium sand with little to some silt observed																
20		20.0 Becomes dense to very dense Log continued on next page																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-6 PROBE

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest DRILLING METHOD: Hydraulic Direct Push DATUM: Local ELEVATION: 820
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 9/27/10 AZIMUTH: N/A INCLINATION: -90
 LOCATION: Fill east of LDA Cover DRILL RIG: Geoprobe 7720DT COORDINATES: N: 1,713,164.94 E: 127,156.60

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
					DEPTH (ft)						W _p	W _L	W _u		W _s	
20	Hydraulic Direct Push 2.25-Inch Rod Diameter	Sample S-6 collected at 20 ft bgs 0.0 - 28.0 Loose to very dense, medium brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little fine gravel, little organics (rootlets, wood fragments), damp to moist, organic odor (SM) (FILL-MINE SPOILS) <i>(Continued)</i> 21.0 - 22.0 Light gray, fine to medium sand with little to some silt observed Sample S-7 collected at 21 ft bgs	SM													
25		25.0 - 28.0 Light to medium gray, mottled, silty fine to medium sand to silt with little to some fine to medium sand observed No groundwater encountered at time of probing					Run 5	GRAB				3.0 5.0				
30		28.0 Refusal on cobble, boulder or bedrock Boring completed at 28.0 ft.					792.0 28.0									
35																
40																

Soil density estimated from probe action

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



RECORD OF BOREHOLE P-10 PROBE

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hydraulic Direct Push
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: MWB-3LDA

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,016.99 E: 126,268.70

ELEVATION: 740
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						20	40	60		80
0	Hydraulic Direct Push 2.25-Inch Rod Diameter	0.0 - 10.0 Compact to dense, light to medium gray to medium brown, mottled, heterogeneous, silty fine to medium SAND, little fine gravel, little organics (rootlets, wood fragments), scattered fine-grained coal fragments, damp (SM) (FILL-MINE SPOILS)	SM												
		Sample S-1 collected at 2 ft bgs				Run 1	GRAB			2.5 5.0					
5			Sample S-2 collected at 7 ft bgs			Run 2	GRAB			3.3 5.0					
10			10.0 - 13.0 Zone of fine-grained coal			730.0 10.0									
		Sample S-3 collected at 11 ft bgs	PT												
		Run 3 GRAB			727.0 13.0	Run 3	GRAB			4.0 5.0					
15		13.0 - 18.0 Dense, olive brown, mottled, heterogeneous, mix of silty fine to medium SAND and sandy SILT, little fine gravel, little organics (rootlets), moist (SM) (FILL-MINE SPOILS)	SM												
		Sample S-4 collected at 15 ft bgs				Run 4	GRAB			2.8 3.0					
		No groundwater encountered at time of probing			722.0 18.0										
20		Refusal on cobble/boulder/bedrock Boring completed at 18.0 ft.													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

Soil density estimated from probe action

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: K. Goble

LOGGED: S. Morgan
 CHECKED: J. DeLaChapelle
 DATE: 10/7/2010



**APPENDIX A-2.1
BORING LOGS**

RECORD OF BOREHOLE P-4A HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/16/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,901.94 E: 126,734.19

ELEVATION: 752
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W_p ----- W_L 20 40 60 80				
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 2.0 Compact to dense, medium brown, mottled, heterogeneous, mix of silty fine to medium SAND and cohesive, low plasticity SILT, little to some organics (rootlets), scattered pockets of fine-grained coal fragments, damp (CL) (FILL-LOW PERMEABILITY SOIL COVER)	CL		750.0										
5		2.0 - 10.0 Loose, medium gray, mottled, heterogeneous, mix of SILT and fine to medium SAND, little fine to coarse subrounded to subangular gravel, moist (SM) (FILL-MINE SPOILS)	SM		2.0										
5.0 - 5.5		Scattered organics (rootlets) observed	SM			S-1	CA	5-4-5	9	1.1 1.5					■
10	Hollow Stem Auger 8-inch Casing Diameter	10.0 - 27.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, dry to damp (FILL-IMPORTED CEMENT KILN DUST)	N/A		742.0										
			N/A		10.0	S-2	CA	50/6"	>50	0.9 0.5					>> ■
15				N/A			S-3	CA	40-50/5"	>50	1.5 1.0				>> ■
20		Log continued on next page													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-4A HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/16/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,901.94 E: 126,734.19

ELEVATION: 752
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L	W _u		
20	Hollow Stem Auger 8-inch Casing Diameter	10.0 - 27.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, dry to damp (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A	[Cross-hatched pattern]		S-4	CA	32-50/4"	>50	1.5 1.0					>>■
						S-5	CA	50/5"	>50	0.4 0.4					>>■
						S-6	SPT	60/6"	>50	0.3 0.5					>>■
		No groundwater encountered at time of drilling			724.5 27.5										
		The drilling conditions are too dense and the angle of the drill is too great to continue drilling Boring completed at 27.5 ft.													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-1 HSA

SHEET 2 of 3

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 12/2/10
 LOCATION: Fill east of LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,045.00 E: 127,291.00
 ELEVATION: 820
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)						
					DEPTH (ft)						20	40	60		80		
20	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 30.0 Loose to very dense, medium brown to gray, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine subrounded gravel, scattered pockets of fine-grained coal fragments, little organics (rootlets), damp to moist (SM) (FILL- MINE SPOILS) (Continued)	SM	[Cross-hatched pattern]		S-1	CA	6-24-40	>50	0.4 1.5					>> ■		
25						S-2	CA	30-50/6"	>50	1.0 1.0						>> ■	
30						S-3	CA	50/3"	>50	0.5 0.3							>> ■
35						S-4	CA	50/3"	>50	0.6 0.3							>> ■
40		No groundwater encountered at time of drilling															
		Log continued on next page															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-1 HSA

SHEET 3 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: Fill east of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,045.00 E: 127,291.00
 ELEVATION: 820
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _p		W _L
40		Boring completed at 40.3 ft.	N/A	/ / / / /	779.8 40.3	S-5	CA	50/3"	>50	0.5 0.3					>>■
45															
50															
55															
60															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-2 HSA

SHEET 1 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,130.00 E: 127,000.00
 ELEVATION: 795
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L	W _u		
0		0.0 - 25.0 Compact to very dense, medium gray, non-stratified, SILT, dry to damp (ML) (FILL- MINE SPOILS WITH SILTSTONE)		X X X X											
5		5.0 - 15.0 Driller notes gravel zone		X X X X											>> ■
10	Hollow Stem Auger 8-inch Casing Diameter	11.0 - 11.2 Zone of orange-gray coloring observed	ML	X X X X											■
15		15.5 - 16.0 Orange-gray, silty fine to medium sand with some fine to medium subrounded to subangular gravel, scattered fine-grained coal fragments, and trace fibrous wood debris observed		X X X X											■
20		Log continued on next page		X X X X											

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-2 HSA

SHEET 2 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,130.00 E: 127,000.00

ELEVATION: 795
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■		NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L			
20	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 25.0 Compact to very dense, medium gray, non-stratified, SILT, dry to damp (ML) (FILL- MINE SPOILS WITH SILTSTONE) (Continued) 20.0 - 21.5 Scattered pockets of orange-gray silty fine to medium sand with some fine to medium subrounded to subangular gravel observed	ML	[Cross-hatched pattern]	770.0	S-4	CA	4-10-15	25	0.8 1.5	■				
25		25.0 - 40.5 Slightly weathered, non-stratified, light gray (N7), fine-grained, extremely weak (R0), dry to damp, SANDSTONE (PUGET GROUP) 25.0 Driller notes large void during backfill			N/A	[Diagonal line pattern]	25.0	S-5	CA	50/3"	>50	0.3 0.3	>>■		
30							S-6	CA	50/4"	>50	0.6 0.3	>>■			
35		S-7	CA	50/6"			>50	0.4 0.5	>>■						
40		Log continued on next page													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-2 HSA

SHEET 3 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,130.00 E: 127,000.00

ELEVATION: 795
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _u		W _c
40		No groundwater encountered at time of drilling Boring completed at 40.5 ft.	N/A	[Hatched Box]	754.5 40.5	S-8	CA	50/6"	>50	0.6 0.5					>>■
45															
50															
55															
60															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-3 HSA

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/3/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,162.51 E: 126,150.12

ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
					DEPTH (ft)						W _p	W _L	W _u			
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 8.0 Very dense, olive brown to medium gray, mottled, non-stratified, silty fine to coarse SAND, little to some fine subrounded to subangular gravel, scattered cobble/boulder fragments, socketing, damp (SM) (FILL-MINE SPOILS)	SM		737.0											
5					S-1	CA	50/4"	>50	1.2 0.3	>>						
								8.0	S-2	CA	50/5"	>50	0.3 0.4	>>		
10		The drilling conditions too dense to continue drilling; may have encountered bedrock or a large boulder Boring completed at 8.0 ft.														
15																
20																

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

RECORD OF BOREHOLE B-5 HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/3/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,191.12 E: 126,125.55

ELEVATION: 746
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W_p ----- W_u 20 40 60 80				
0		0.0 - 20.0 Very dense, olive brown, heterogeneous, silty fine to coarse SAND, some fine to coarse subrounded to subangular gravel, scattered cobble/boulder fragments, socketing, damp to moist (SM) (FILL-MINE SPOILS)		X											
5		5.0 - 6.0 Orange-brown mottling observed		X											>> ■
				X											>> ■
				X											>> ■
10	Hollow Stem Auger 8-inch Casing Diameter		SM	X											>> ■
				X											>> ■
				X											>> ■
				X											>> ■
				X											>> ■
				X											>> ■
20		Log continued on next page		X											>> ■
				X											>> ■

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-5 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/3/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,191.12 E: 126,125.55
 ELEVATION: 746
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
											W_p ----- W_L 20 40 60 80					
20	Hollow Stem Auger 8-inch Casing Diameter	20.0 - 22.5 Very dense, medium gray, non-stratified, fine to coarse SAND, some fine to medium subrounded gravel, little silt, moist (SP-GP) (FILL)	SP-GP		20.0	S-7	CA	50/5"	>50	0.4 0.4					>>■	
		22.5 - 32.6 Slightly weathered, non-stratified, very light gray (N8), fine-grained, extremely weak (R0), damp, SANDSTONE (PUGET GROUP)	N/A		723.5 22.5	S-8	CA	50/5"	>50	0.0 0.4						>>■
		22.5 - 30.0 No sample recovery					S-9	CA	50/3"	>50	0.0 0.3					>>■
							S-10	CA	100/5"	>50	0.0 0.4					>>■
							S-11A	CA	50/2"	>50	0.0 0.2					>>■
						S-11B	SPT	70/5"	>50	0.4 0.4					>>■	
					713.4 32.6	S-12	SPT	70/2"	>50	0.0 0.1					>>■	
			Boring completed at 32.6 ft.													>>■

Groundwater measured at 31.70 ft BGS ATD (borehole depth 32.5 ft)

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011




RECORD OF BOREHOLE B-6 HSA

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/3/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,180.30 E: 126,137.77
 ELEVATION: 746
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						20	40	60	80	
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 11.0 Very dense, olive to medium brown, mottled, non-stratified, silty fine to coarse SAND, some fine to coarse subrounded to subangular gravel, scattered cobble/boulder fragments, socketing, damp (SM) (FILL-MINE SPOILS)	SM												
5		5.0 Organics (rootlets) observed				S-1	CA	50/5"	>50	0.8 0.4	>> ■				
10		No groundwater encountered at time of drilling				S-2	CA	50/1"	>50	0.0 0.1	>> ■				
11.0		The drilling conditions too dense to continue drilling; may have encountered bedrock or a large boulder Boring completed at 11.0 ft.				S-3	CA	50/3"	>50	0.3 0.3	>> ■				

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-7 HSA

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/3/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,185.62 E: 126,130.47
 ELEVATION: 746
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L	W _p		W _L
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 3.0 No sample recovery. Cuttings indicate: Very dense, olive to medium brown, silty fine to coarse SAND, some fine to coarse subrounded to subangular gravel, scattered cobble/boulder, damp (SM) (FILL-MINE SPOILS)	SM		743.0										
3.0		No groundwater encountered at time of drilling													
5		The drilling conditions too dense to continue drilling; may have encountered bedrock or a large boulder Boring completed at 3.0 ft.													
10															
15															
20															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-9 HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/6/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,153.23 E: 126,866.95

ELEVATION: 795
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)						
					DEPTH (ft)						W _p	W _L	W _u				
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 15.0 Dense to very dense, olive brown, mottled, heterogenous, silty fine to medium SAND, little fine to medium subrounded to subangular gravel, scattered cobble/boulder fragments, scattered fine-grained coal fragments, trace organics (wood fibers), damp (SM) (FILL- MINE SPOILS)	SM	X													
5					S-1	CA	50/6"	>50	0.9 0.5								>> ■
					S-2	CA	7-7-7	14	1.5				■				
10					S-2	CA	25-23-12	35	0.5 1.5						■		
					S-4	CA	4-8-10	18	1.5						■		
15					S-3	CA	50/5"	>50	0.5 0.4								>> ■
20						15.0 - 35.5 Fresh, massive, brownish gray (5YR 4/1), very fine-grained to fine-grained, extremely weak (R0), dry, SILTSTONE, local coal seams (PUGET GROUP)	N/A	Z									

Log continued on next page

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-9 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/6/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,153.23 E: 126,866.95

ELEVATION: 795
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS				
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)								
					DEPTH (ft)						W _p	W _L	W _u						
20	Hollow Stem Auger 8-inch Casing Diameter	15.0 - 35.5 Fresh, massive, brownish gray (5YR 4/1), very fine-grained to fine-grained, extremely weak (R0), dry, SILTSTONE, local coal seams (PUGET GROUP) (Continued)	N/A			S-4	CA	50/5"	>50		0.5 0.4					>>■			
						S-5	CA	50/5"	>50		0.6 0.4					>>■			
						S-6	CA	50/3"	>50		0.3 0.3					>>■			
						S-7	CA	50/5"	>50		0.5 0.4					>>■			
						S-8	CA	50/5"	>50		0.6 0.4					>>■			
						S-9	CA	50/6"	>50		0.7 0.5					>>■			
						S-10	CA	50/6"	>50		0.5 0.5					>>■			
						No groundwater encountered at time of drilling													
						Boring completed at 35.5 ft.													
									759.5 35.5										

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-10 HSA

SHEET 1 of 1

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013 DRILLING METHOD: Hollow Stem Auger
 LOCATION: Access Road @ Main Road DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,133.31 E: 126,202.04

ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _p		W _L
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 10.2 Very dense, olive brown, mottled, non-stratified, silty fine to medium SAND, some fine to coarse subrounded to subangular gravel, scattered cobble/boulder fragments, socketing, damp (SM) (FILL-MINE SPOILS)	SM												
5					S-1	CA	50/6"	>50	0.6 0.5	>> ■					
10					S-2	CA	50/1"	>50	0.5 0.1	>> ■					
10.2					S-3	CA	50/2"	>50	0.4 0.2	>> ■					
		No groundwater encountered at time of drilling			734.8 10.2										
		The drilling conditions too dense to continue drilling; may have encountered bedrock or a large boulder Boring completed at 10.2 ft.													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



**APPENDIX A-2.2
PIEZOMETER LOGS**

RECORD OF BOREHOLE P-1 HSA

SHEET 2 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/29/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,881.46 E: 127,626.70

ELEVATION: 747
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)						
											W_p ----- W_L 20 40 60 80						
20	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 35.0 Loose to dense, medium brown to medium gray, mottled, nonstratified, mix of silty fine to medium SAND and fine to medium sandy SILT, trace cobbles, little to some organics (rootlets), damp to moist (SM) (FILL-MINE SPOILS) (Continued)	SM														
25						S-1	CA	50/4"	>50	0.3 0.3	>>	■					
30							S-2	CA	50/4"	>50	0.1 0.3	>>	■	2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips			
35		35.0 - 55.3 Fresh, massive, light brownish gray (5YR 6/1), fine-grained, weak (R2), dry, SILTSTONE (PUGET GROUP)	N/A		712.0 35.0												
40					S-3	CA	50/4"	>50	0.3 0.3	>>	■						

Log continued on next page

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-1 HSA


SHEET 3 of 3

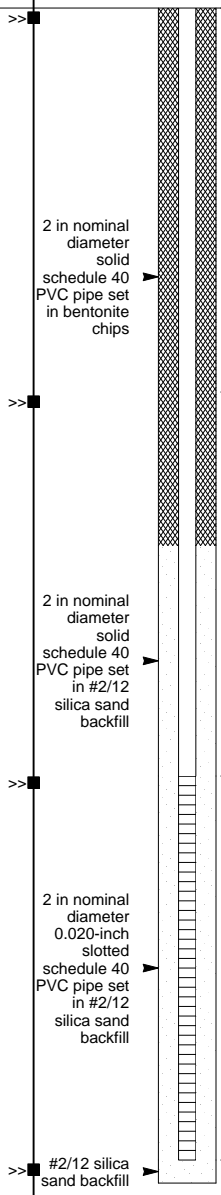
PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/29/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,881.46 E: 127,626.70

ELEVATION: 747
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE		NOTES WATER LEVELS GRAPHIC					
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	BLOWS / ft		WATER CONTENT (PERCENT) W _p ----- W _L 20 40 60 80				
											10			20	30	40	
40	Hollow Stem Auger 8-inch Casing Diameter	35.0 - 55.3 Fresh, massive, light brownish gray (5YR 6/1), fine-grained, weak (R2), dry, SILTSTONE (PUGET GROUP) <i>(Continued)</i>	N/A		691.7 55.3	S-4	CA	50/3"	>50	0.3 0.3			>>				
45		45.0 Localized seam of fine-grained coal observed							S-5	CA	50/3"	>50	0.3 0.3			>>	
50									S-6	CA	50/2"	>50	0.4 0.2			>>	
55		No groundwater encountered at time of drilling Boring completed at 55.3 ft.							S-7	CA	50/3"	>50	0.5 0.3			>>	
60																	



BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-3 HSA

SHEET 2 of 4

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/16/10
 LOCATION: LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 ELEVATION: 780
 INCLINATION: -90
 COORDINATES: N: 1,713,003.09 E: 126,929.39

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC				
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)							
											W_p ----- W_L 20 40 60 80							
20	Hollow Stem Auger 8-inch Casing Diameter	10.0 - 65.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, dry to wet (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A															
					S-4	CA	50/5"	>50	$\frac{1.0}{0.4}$									
25		25.5 Slightly cohesive cement kiln dust with trace to little fine gravel observed					S-5	CA	50/6"	>50	$\frac{1.0}{0.5}$							
							S-6	CA	50/5"	>50	$\frac{1.1}{0.4}$							
30																		
35		35.0 Band of slightly cohesive cement kiln dust observed			S-7	CA	50/6"	>50	$\frac{1.0}{0.5}$									
40		Log continued on next page																

2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-3 HSA

SHEET 3 of 4

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/16/10
 LOCATION: LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,003.09 E: 126,929.39
 ELEVATION: 780
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											10	20	30		40
40	Hollow Stem Auger 8-inch Casing Diameter	10.0 - 65.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, dry to wet (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A			S-8	CA	50/6"	>50	1.5 0.5					
45		45.0 - 65.0 Moisture content increases from moist to wet			S-9	CA	50/6"	>50	1.0 0.5						
50					S-10	CA	50/5"	>50	0.8 0.4						
55		55.0 Band of slightly cohesive cement kiln dust observed			S-11A	CA	50/6"	>50	1.1 0.5						
60		Log continued on next page													

2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips

2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-3 HSA

SHEET 4 of 4

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/16/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,003.09 E: 126,929.39

ELEVATION: 780
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■		NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)		
					DEPTH (ft)						W _p		W _L
60	Hollow Stem Auger 8-inch Casing Diameter	10.0 - 65.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, dry to wet (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A	[Cross-hatched pattern]		S-12	CA	50/6"	>50	$\frac{0.8}{0.5}$			2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill #2/12 silica sand backfill
65		No groundwater encountered at time of drilling				S-13	CA	50/5"	>50	$\frac{0.5}{0.4}$			
		Boring completed at 65.5 ft.			714.5 65.5								
70													
75													
80													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011




RECORD OF BOREHOLE P-4B HSA

SHEET 2 of 4

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/30/10
 LOCATION: LDA Toe Ditch
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,901.94 E: 126,734.19
 ELEVATION: 735
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft		NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)		
					DEPTH (ft)						W _p		W _L
20	Hollow Stem Auger 8-inch Casing Diameter	20.0 - 25.0 Lightly weathered, locally stratified, dark yellowish orange (10YR 6/6), fine-grained, extremely weak (R0), dry, silty fine-grained SANDSTONE (PUGET GROUP)	N/A		20.0	S-4	CA	50/4"	>50	0.4 0.3			2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill #2/12 silica sand backfill Bentonite chip backfill
25		25.0 - 60.0 Slightly weathered, non-stratified, medium light gray (N6), fine-grained, extremely weak (R0), dry, SANDSTONE, quartz grains, subangular (PUGET GROUP)			710.0 25.0	S-5	CA	50/5"	>50	0.4 0.4			
30						S-6	CA	50/4"	>50	0.4 0.3			
35				S-7	CA	50/2"	>50	0.5 0.2					
40													

Log continued on next page

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011


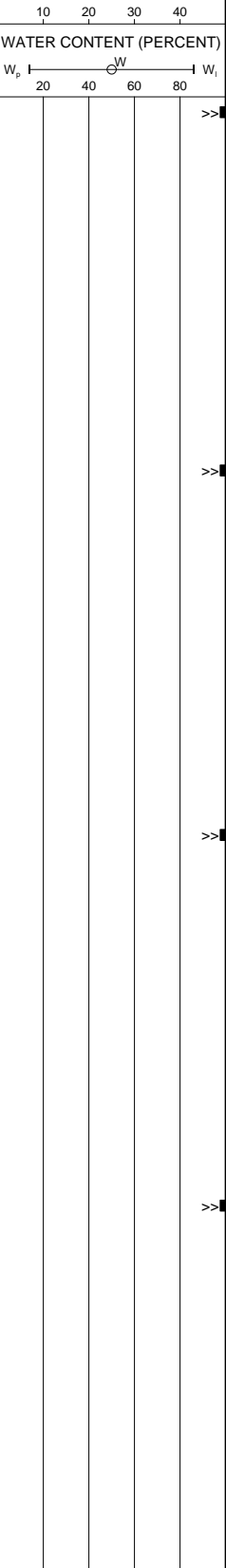


RECORD OF BOREHOLE P-4B HSA

SHEET 3 of 4

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/30/10
 LOCATION: LDA Toe Ditch
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,901.94 E: 126,734.19
 ELEVATION: 735
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _u		W _g
40	Hollow Stem Auger 8-inch Casing Diameter	25.0 - 60.0 Slightly weathered, non-stratified, medium light gray (N6), fine-grained, extremely weak (R0), dry, SANDSTONE, quartz grains, subangular (PUGET GROUP) <i>(Continued)</i>	N/A		S-8	CA	50/5"	>50	0.5 0.4	>>					
45					S-9	CA	50/3"	>50	0.4 0.3	>>					
50					S-10	CA	50/3"	>50	0.4 0.3	>>					
55					S-11	CA	50/5"	>50	0.4 0.4	>>					
60		675.0	Log continued on next page												

Bentonite chip backfill

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-4B HSA

SHEET 4 of 4

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Toe Ditch

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/30/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,901.94 E: 126,734.19

ELEVATION: 735
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
											W _p I ——— W _L					
60	Hollow Stem Auger 8-inch Casing Diameter	60.0 - 65.3 Slightly weathered, non-stratified, dark yellowish orange (10YR 6/6), fine-grained, extremely weak (R0), dry, SANDSTONE, quartz grains, subangular (PUGET GROUP)	N/A		60.0	S-12	CA	50/5"	>50	0.5 0.4					>>■	
65		No groundwater encountered at time of drilling			669.8	S-13	CA	50/3"	>50	0.4 0.3					>>■	
		Boring completed at 65.3 ft.			65.3											
70																
75																
80																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-5 HSA

SHEET 2 of 3

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/17/10
 LOCATION: LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 ELEVATION: 770
 INCLINATION: -90
 COORDINATES: N: 1,713,037.39 E: 126,646.68

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC	
											W_p ----- W_L 20 40 60 80					
20	Hollow Stem Auger 8-inch Casing Diameter	12.0 - 50.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, scattered pockets of fine-grained coal fragments, scattered pockets of mine spoils, dry to moist (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A		S-1	CA	50/6"	>50	0.7 0.5					>>■	2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips	
25					S-2	CA	50/6"	>50	0.8 0.5					>>■		
30					S-3	CA	35-50/6"	>50	1.0 1.0					>>■		
35					S-4	CA	20-25-50/3"	>50	1.5 1.3					>>■		
40					Log continued on next page											

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-5 HSA

SHEET 3 of 3

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/17/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,037.39 E: 126,646.68

ELEVATION: 770
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC				
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)							
											W_p ----- W_L 20 40 60 80							
40	Hollow Stem Auger 8-inch Casing Diameter	12.0 - 50.5 Very dense, light gray, mottled, heterogeneous, cement kiln dust, scattered pockets of fine-grained coal fragments, scattered pockets of mine spoils, dry to moist (FILL-IMPORTED CEMENT KILN DUST) (Continued)	N/A		719.5 50.5	S-5	CA	50/3"	>50	$\frac{0.4}{0.3}$					>> ■ 2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips 2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill Groundwater measured at 45.50 ft BGS ATD (borehole depth 50 ft) 2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill >> ■ #2/12 silica sand backfill			
45										S-6	CA	50/6"	>50	$\frac{1.5}{0.5}$				
50										S-7	CA	50/6"	>50	$\frac{1.5}{0.5}$				
		Boring completed at 50.5 ft.																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-6 HSA

SHEET 2 of 5

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/18/10
 LOCATION: Fill east of LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 ELEVATION: 820
 INCLINATION: -90
 COORDINATES: N: 1,713,164.94 E: 127,156.60

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC					
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)								
					DEPTH (ft)						W _p	W _L	W _u	W _s					
20	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 65.0 Loose to very dense, medium brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine gravel, little organics (rootlets, wood fragments), trace fine-grained coal fragments, damp to moist (SM) (FILL-MINE SPOILS) (Continued)	SM	[Cross-hatched pattern]															
25																			
30									S-1	CA	20-22-22	44	1.1 1.5	■	2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips				
35									S-2	CA	19-20-40	>50	1.2 1.5	>>■					
40		Log continued on next page		[Cross-hatched pattern]															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-6 HSA

SHEET 3 of 5

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 11/18/10
 LOCATION: Fill east of LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 ELEVATION: 820
 INCLINATION: -90
 COORDINATES: N: 1,713,164.94 E: 127,156.60

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC						
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)										
											W_p ----- W_L 20 40 60 80										
40	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 65.0 Loose to very dense, medium brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine gravel, little organics (rootlets, wood fragments), trace fine-grained coal fragments, damp to moist (SM) (FILL-MINE SPOILS) (Continued)	SM	[Cross-hatched pattern]																	
					S-3	CA	50/6"	>50	$\frac{0.3}{0.5}$												
					S-4	CA	30-50/6"	>50	$\frac{1.0}{1.0}$												
					S-5	CA	28-43-50/6"	>50	$\frac{1.2}{1.2}$												
					S-6	CA	32-50/6"	>50	$\frac{0.8}{1.0}$												
45																					
50		50.0 Zone of tan to orange-brown fine to medium sand observed																			
55		56.0 Angular cobble/boulder fragments observed																			
60		Log continued on next page																			

2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-6 HSA

SHEET 4 of 5

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: Fill east of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/18/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,164.94 E: 127,156.60

ELEVATION: 820
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft		NOTES WATER LEVELS GRAPHIC
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)		
					DEPTH (ft)						W _p	W _L	
60	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 65.0 Loose to very dense, medium brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine gravel, little organics (rootlets, wood fragments), trace fine-grained coal fragments, damp to moist (SM) (FILL-MINE SPOILS) (Continued)	SM		755.0	S-7	CA	24-37-50/4"	>50	0.0 1.3			>>
65		65.0 - 70.0 Zone of fine-grained coal	PT		65.0	S-8	CA	50/6"	>50	0.3 0.5			>>
70		70.0 - 80.1 Highly weathered, non-stratified, mottled, grayish orange (10YR 7/4) to light olive gray (5YR 5/2), fine-grained, extremely weak (R0), dry, silty SANDSTONE, local thin coal seams (PUGET GROUP)	N/A		750.0	S-9	CA	26-50/6"	>50	1.1 1.0			>>
75		75.0 Less mottling observed	N/A			S-10	CA	50/2"	>50	0.5 0.2			>>
80		Log continued on next page											

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-6 HSA

SHEET 5 of 5

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: Fill east of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/18/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,164.94 E: 127,156.60

ELEVATION: 820
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
					DEPTH (ft)						W _p	W _L	W _u		
80		Boring completed at 80.1 ft.		//	78.9 80.1	S-11	CA	50/1"	>50	0.6 0.1					#2/12 silica sand backfill
85															
90															
95															
100															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-8 HSA

SHEET 2 of 4

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 11/18/10
 LOCATION: East of Access Road and LDA

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,322.53 E: 126,774.16
 ELEVATION: 815
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft		NOTES WATER LEVELS GRAPHIC			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p		W _L		
20	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 60.5 Dense to very dense, tan to olive brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine subrounded gravel, scattered fine-grained coal fragments, little organics (rootlets, wood fragments), damp to wet (SM) (FILL-MINE SPOILS) (Continued)	SM			S-5	CA	50/4"	>50	$\frac{0.2}{0.3}$			>>		
		20.0 3-inch diameter granite cobble core observed													
25								S-6	CA	50/6"	>50	$\frac{0.0}{0.5}$			>>
30		30.5 - 31.0 Zone of fine-grained coal fragments observed				S-7	CA	19-24-50/6"	>50	$\frac{1.0}{1.5}$			>>		
													2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips		
35		35.0 - 40.0 Pockets of yellow-orange fine to medium sand				S-8	CA	7-10-23	33	$\frac{1.5}{1.5}$	■				
40		Log continued on next page													

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-8 HSA

SHEET 3 of 4

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 11/18/10
 LOCATION: East of Access Road and LDA

DRILLING METHOD: Hollow Stem Auger
 DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,322.53 E: 126,774.16
 ELEVATION: 815
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
											W_p ----- W_L 20 40 60 80					
40	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 60.5 Dense to very dense, tan to olive brown to gray, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine subrounded gravel, scattered fine-grained coal fragments, little organics (rootlets, wood fragments), damp to wet (SM) (FILL-MINE SPOILS) (Continued)	SM	[Cross-hatched pattern]		S-9	CA	18-30-24	>50	1.5 1.5					>> ■	
45						S-10	CA	21-24-36	>50	1.5 1.5						>> ■
50						S-11	CA	27-40-36	>50	1.5 1.5						>> ■
55						S-12	CA	20-50/6*	>50	1.5 1.0						>> ■
60						55.0 Pocket of fine-grained coal fragments observed										
Log continued on next page																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-8 HSA

SHEET 4 of 4

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 11/18/10
 LOCATION: East of Access Road and LDA

DRILLING METHOD: Hollow Stem Auger
 DATUM: Local
 AZIMUTH: N/A

ELEVATION: 815
 INCLINATION: -90

DRILLER: CME 65 Limited Access
 COORDINATES: N: 1,713,322.53 E: 126,774.16

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES			
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				WATER LEVELS	GRAPHIC	
					DEPTH (ft)						10	20	30	40			W _p
60		Boring completed at 60.5 ft.	SM	[Cross-hatched]	754.5 60.5	S-13	CA	50/6"	>50	0.3 0.5							#2/12 silica sand backfill
65																	
70																	
75																	
80																	

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-9 HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of MWB-3LDA

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,089.87 E: 126,260.19

ELEVATION: 740
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p	W _L	W _U		W _h
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 5.0 Very dense, light to medium brown, mottled, heterogeneous, mix of silty fine to medium SAND and SILT, little to some fine subrounded to subangular gravel, scattered cobbles, damp to wet (SM) (FILL-MINE SPOILS)	SM												Flush-mount monument set in concrete with locked well cap 2 in nominal diameter solid schedule 40 PVC pipe set in cement 2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips Groundwater measured at 9.60 ft BGS ATD (borehole depth 20 ft) 2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill 2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill
5		5.0 - 20.4 Highly weathered, non-stratified, mottled, grayish orange (10YR 7/4) to dark yellowish orange (10YR 6/6), fine-grained, extremely weak (R0), dry, SANDSTONE (PUGET GROUP)	N/A		735.0										
					5.0	S-1	CA	50/2"	>50	1.5	0.2				
					S-2	CA	50/2"	>50	0.0	0.2					
					S-3	CA	50/5"	>50	0.4	0.4					

Log continued on next page

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-9 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: East of MWB-3LDA

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/2/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,089.87 E: 126,260.19

ELEVATION: 740
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				
											W _p I ———— W _L 20 40 60 80				
20		20.0 - 20.4 Pockets of light gray fine to medium sand and iron-oxide staining observed Boring completed at 20.4 ft.	N/A		719.6 20.4	S-4	CA	50/5"	>50	<u>0.8</u> 0.4					>> ■ #2/12 silica sand backfill
25															
30															
35															
40															

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-11 HSA


SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: Adjacent to MWB-2LDA

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 11/15/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,712,741.18 E: 127,159.00

ELEVATION: 735
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■		NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)		GRAPHIC	
											W _p	W _L		
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 20.5 Compact to very dense, mottled, olive brown to medium gray, heterogeneous, mix of silty fine to medium SAND and SILT, some fine to coarse subrounded to subangular gravel, scattered cobble/boulder fragments, scattered pockets of fine-grained coal fragments, damp to wet (SM) (FILL-MINE SPOILS)	SM											Flush-mount monument set in concrete with locked well cap 2 in nominal diameter solid schedule 40 PVC pipe set in cement 2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips 2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill Groundwater measured at 13.21 ft BGS ATD (borehole depth 20 ft) 2 in nominal diameter 0.010-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill #2/12 silica sand backfill
5					S-1	CA	18-18-14	32	1.0 1.5	■				
10					S-2	CA	10-10-18	28	1.5 1.5	■				
15					S-3	CA	8-10-50/6"	>50	1.3 1.5	■				
20		20.0 Debris (metal wire) observed Log continued on next page												

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-11 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013 DRILLING METHOD: Hollow Stem Auger
 LOCATION: Adjacent to MWB-2LDA DRILL RIG: CME 65 Limited Access

DATUM: Local ELEVATION: 735
 AZIMUTH: N/A INCLINATION: -90
 COORDINATES: N: 1,712,741.18 E: 127,159.00

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC	
					DEPTH (ft)						W _p	W _L	W _u			
20		Boring completed at 20.5 ft.	SM	[Cross-hatched]	714.5 20.5	S-4	CA	50/6"	>50	0.5 0.5					>>■	
25																
30																
35																
40																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE P-12

SHEET 2 of 2
ELEVATION: 760
INCLINATION: -90

PROJECT: Holcim/LowerDisposalArea/WA DRILLING METHOD: Hollow Stem Auger DATUM: AZIMUTH: N/A
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 12/13/2011 LOCATION: About 180 ft West of B-11 DRILL RIG: CME55 Limited Access Track-Mo COORDINATES: not surveyed

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS						
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC						
					DEPTH (ft)						W _p	W _L	W _U	W _h							
20	4 1/4-inch inner diameter hollow stem auger with 140 lb wireline safety hammer	4.5 - 35.5 Fresh, bedded, orange gray to yellow brown to light gray, fine sand grained, extremely weak (R0), SANDSTONE. <i>(Continued)</i>	N/A	[Dotted Pattern]		9	SS	20-30-50	>50	1.3 1.5											
						9	SS	28-50/6"	>50	1.0 1.0											
25						10	SS	50/5"	>50	0.4 0.4											
						11	SS	50/6"	>50	0.5 0.5											
30						12	SS	50/5"	>50	0.4 0.4											
						13	SS	50/6"	>50	0.5 0.5											
35						14	SS	50/6"	>50	0.5 0.5											
						Boring completed at 35.5 ft.															
									724.5 35.5												
40																					

BOREHOLE RECORD 07393074-02.013_P-12_AND_P-13.GPJ GLDR_WA.GDT 6/11/13

Groundwater measured 31.5 ft bgs during drilling at 13:30 on 12/13/11.

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling, Inc
 DRILLER: C. Askew

LOGGED: A. Dennison
 CHECKED: S. Morgan
 DATE: 12/16/2011



RECORD OF BOREHOLE P-13

SHEET 1 of 3
ELEVATION: 800
INCLINATION: -90

PROJECT: Holcim/LowerDisposalArea/WA DRILLING METHOD: Hollow Stem Auger DATUM: AZIMUTH: N/A
 PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 12/12/2011 COORDINATES: not surveyed
 LOCATION: About 140 ft North of P-12 DRILL RIG: CME55 Limited Access Track-Mo

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
					DEPTH (ft)						W _p ----- W _L 20 40 60 80					
0	4 1/4-inch inner diameter hollow stem auger with 140 lb wireline safety hammer	0.0 - 4.5 Loose to compact, brown to brown-gray, heterogeneous, silty fine to coarse SAND, some fine to coarse angular to subangular gravel, coarse-sand-sized fragments of coal, trace pockets of iron-oxide staining, damp (SM) (FILL)	SM		795.5 4.5	1	SS	10-13-15	28	0.4 1.5					DOE Well No. BHK 280 Flush-mount monument set in concrete.	
5		4.5 - 7.0 Loose, brown to dark brown, heterogeneous, silty fine to coarse SAND, some fine to coarse angular to subangular gravel, coarse-sand-sized fragments of coal, trace pockets of iron-oxide staining, damp. (SM) (FILL)	SM		793.0 7.0	3	SS	4-3-3	6	0.8 1.5						
10		7.0 - 10.3 Compact, gray-brown, heterogeneous, fine to coarse SAND, little fine to coarse gravel, damp to moist (SM) (FILL)	SM		789.7 10.3	4	SS	3-3-14	17	0.9 1.5						
15		10.3 - 24.0 Slightly weathered, foliated, black, very fine grained, extremely weak (R0), COAL.	N/A			5	SS	5-7-10	17	0.7 1.5						
20						8	SS	50/4"	>50	0.7 0.3						

Groundwater measured 10.56 ft btc at 10:35 am on 12/13/11.

BOREHOLE RECORD 07393074-02.013_P-12_AND_P-13.GPJ GLDR_WA.GDT 6/11/13

Log continued on next page

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling, Inc
 DRILLER: C. Askew

LOGGED: A. Dennison
 CHECKED: S. Morgan
 DATE: 12/16/2011



RECORD OF BOREHOLE P-13

SHEET 2 of 3
ELEVATION: 800
INCLINATION: -90

PROJECT: Holcim/LowerDisposalArea/WA DRILLING METHOD: Hollow Stem Auger DATUM: AZIMUTH: N/A
PROJECT NUMBER: 073-93074-02.013 DRILLING DATE: 12/12/2011 COORDINATES: not surveyed
LOCATION: About 140 ft North of P-12 DRILL RIG: CME55 Limited Access Track-Mo

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC		
20	4 1/4-inch inner diameter hollow stem auger with 140 lb wireline safety hammer	10.3 - 24.0 Slightly weathered, foliated, black, very fine grained, extremely weak (R0), COAL. (Continued)	N/A		776.0	9	SS	50/4"	>50	0.3 0.3							2-inch diameter, schedule 40, PVC pipe embedded in bentonite chips.
					24.0	9	SS	30-50/6"	>50	0.8 1.0							
25		24.0 - 26.0 Slightly weathered, jointed, gray to light gray, very fine grained, extremely weak to very weak (R0-R1), SILTSTONE, trace coal fragments.	N/A		774.0	10	SS	50/4"	>50	0.3 0.3							
					26.0												
		26.0 - 31.5 Slightly weathered, foliated, black, very fine grained, extremely weak (R0), COAL.	N/A		768.5	11	SS	50/5"	>50	0.4 0.4							
30					31.5	12	SS	50/4"	>50	0.3 0.3							
		31.5 - 57.9 Slightly weathered, jointed, gray to light gray, very fine grained, extremely weak to very weak (R0-R1), SILTSTONE, trace coal fragments.	N/A			13	SS	50/5"	>50	0.4 0.5							
35						14	SS	50/3"	>50	0.3 0.3							
						15	SS	50/3"	>50	0.3 0.3							
40																	

Log continued on next page

BOREHOLE RECORD 07393074-02.013_P-12_AND_P-13.GPJ GLDR_WA.GDT 6/11/13

1 in to 3 ft
DRILLING CONTRACTOR: Cascade Drilling, Inc
DRILLER: C. Askew

LOGGED: A. Dennison
CHECKED: S. Morgan
DATE: 12/16/2011



RECORD OF BOREHOLE B-8 HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013
 LOCATION: S of LDA Cover

DRILLING METHOD: Hollow Stem Auger
 DRILLING DATE: 12/6/10
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,206.74 E: 126,117.43

ELEVATION: 747
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC		
											W _p I ———— W _L						
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 15.0 Compact to dense, mottled, medium brown to light gray, heterogeneous, silty fine to medium SAND to SILT with little fine to medium sand, little to some fine subrounded to subangular gravel, scattered cobble/boulder fragments, scattered pockets of light gray to tan fine to medium sand, scattered pockets of fine-grained coal fragments, damp to wet (SM) (FILL-MINE SPOILS)	SM		732.0											Flush-mount monument set in concrete with locked well cap 2 in nominal diameter solid schedule 40 PVC pipe set in cement 2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips 2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill 2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill	
		2.0 12-inch diameter cobble/boulder removed from hole by hand															
5		S-1				CA	22-18-10	28	0.9 1.5								
		S-2				CA	7-7-7	14	0.8 1.5								
		S-3				CA	6-6-6	12	1.0 1.5								
		S-4				CA	4-8-10	18	0.8 1.5								
14.0		14.0 Lens of slightly cohesive, yellow, fine to medium sand observed															
15		15.0 - 25.0 Very dense, olive brown to medium gray, mottled, non-stratified, fine to coarse SAND and fine to coarse subangular to subrounded GRAVEL, little to some silt, wet (SP-GP) (FILL)				SP-GP		15.0	S-5	CA	24-50/6"	>50	1.0 1.0				
	17.5 Organics (twig) observed	S-6	CA	60/2"	>50				0.3 0.2								
20	Log continued on next page																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011


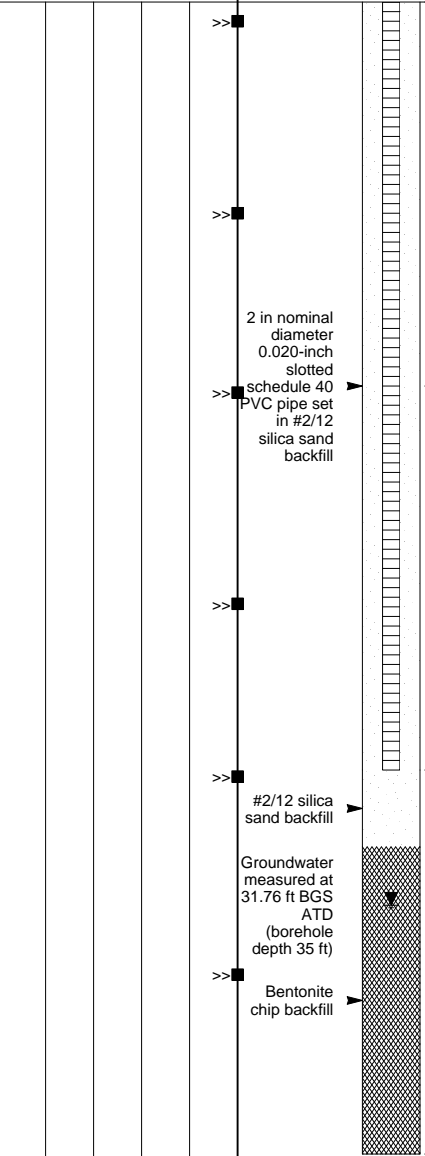



RECORD OF BOREHOLE B-8 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 12/6/10
 LOCATION: S of LDA Cover
 DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 ELEVATION: 747
 INCLINATION: -90
 COORDINATES: N: 1,713,206.74 E: 126,117.43

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES					PENETRATION RESISTANCE BLOWS / ft ■		NOTES WATER LEVELS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)		GRAPHIC	
											W _p	W _L		
20	Hollow Stem Auger 8-inch Casing Diameter	15.0 - 25.0 Very dense, olive brown to medium gray, mottled, non-stratified, fine to coarse SAND and fine to coarse subangular to subrounded GRAVEL, little to some silt, wet (SP-GP) (FILL) (Continued)	SP-GP		722.0	S-7	CA	50/6"	>50	0.8 0.5	>>	 <p style="font-size: small;">2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill</p>		
		S-8				CA	50/6"	>50	0.0 0.5	>>				
25		25.0 - 35.0 Highly weathered, non-stratified, very light gray (N8) to yellowish gray (5Y 8/1), fine-grained, extremely weak (R0), damp, SANDSTONE (PUGET GROUP)				N/A		S-9	CA	50/2"	>50		0.0 0.2	>>
		S-10	CA	32-50/2"	>50			0.8 0.7	>>					
30		S-11	CA	50/2"	>50			0.6 0.2	>>					
		S-12	CA	50/4"	>50			0.6 0.3	>>					
35		S-13	CA	50/4"	>50			0.5 0.3	>>					
		Boring completed at 35.0 ft.			712.0									

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011



RECORD OF BOREHOLE B-11 HSA

SHEET 1 of 2

PROJECT: Resrve Silica LDA Field Invest
 DRILLING METHOD: Hollow Stem Auger
 PROJECT NUMBER: 073-93074-02.013
 DRILLING DATE: 12/7/10
 LOCATION: Access Road @ Main Road DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,129.98 E: 126,211.03
 ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)					
											W _p I ———— W _l I W _u I					
0	Hollow Stem Auger 8-inch Casing Diameter	0.0 - 15.0 Very dense, olive brown to medium gray, mottled, nonstratified, silty fine to medium SAND, little to some fine to coarse subrounded to subangular and faceted gravel, scattered cobble/boulder fragments, contains fragments of intact till incorporated into mine spoils, damp to moist (SM) (FILL-MINE SPOILS)	SM		730.0										Flush-mount monument set in concrete with locked well cap 2 in nominal diameter solid schedule 40 PVC pipe set in cement 2 in nominal diameter solid schedule 40 PVC pipe set in bentonite chips 2 in nominal diameter solid schedule 40 PVC pipe set in #2/12 silica sand backfill 2 in nominal diameter 0.020-inch slotted schedule 40 PVC pipe set in #2/12 silica sand backfill #2/12 silica sand backfill Bentonite chip backfill	
5						S-1	CA	50/2"	>50	0.4 0.2						
7.5		7.5 Little coarse sand observed					S-2	CA	50/1"	>50	0.4 0.1					
10							S-3	CA	50/3"	>50	0.4 0.3					
15							S-4	CA	50/1"	>50	0.3 0.1					
15.0 - 23.0						15.0 - 23.0 Highly weathered, non-stratified, mottled, dark yellowish orange (10YR 6/6), fine-grained, extremely weak (R0), damp, SANDSTONE (PUGET GROUP)	N/A		15.0	S-5A	CA	50/6"	>50	0.7 0.5		
		S-5B	GRAB													
		S-6	CA	50/4"	>50	0.5 0.3										

Log continued on next page

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011




RECORD OF BOREHOLE B-11 HSA

SHEET 2 of 2

PROJECT: Resrve Silica LDA Field Invest
 PROJECT NUMBER: 073-93074-02.013 DRILLING METHOD: Hollow Stem Auger
 LOCATION: Access Road @ Main Road DRILL RIG: CME 65 Limited Access

DATUM: Local
 AZIMUTH: N/A
 COORDINATES: N: 1,713,129.98 E: 126,211.03

ELEVATION: 745
 INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ■				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	WATER CONTENT (PERCENT)				GRAPHIC	
					DEPTH (ft)						W _p	W _L	W _u			
20		15.0 - 23.0 Highly weathered, non-stratified, mottled, dark yellowish orange (10YR 6/6), fine-grained, extremely weak (R0), damp, SANDSTONE (PUGET GROUP) <i>(Continued)</i>	N/A	[Hatched Pattern]	722.0	S-7	CA	50/5"	>50	0.4 0.4					>>■	Groundwater measured at 22.31 ft BGS ATD (borehole depth 22.5 ft) <div style="text-align: right; margin-top: 10px;">  </div>
		Boring completed at 23.0 ft.			23.0	S-9	CA	50/6"	>50	0.3 0.5					>>■	
25																
30																
35																
40																

BOREHOLE RECORD 073-93074-02.013 RESERVE SILICA LDA.GPJ GLDR_WA.GDT 6/10/13

1 in to 3 ft
 DRILLING CONTRACTOR: Cascade Drilling Inc.
 DRILLER: S. Stivers

LOGGED: S. Morgan
 CHECKED: D. Findley
 DATE: 1/12/2011




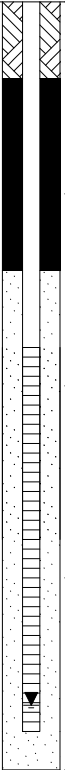


RECORD OF BOREHOLE B-12

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/25/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: N: 126,354 E: 1,353,239

ELEVATION: 758.97
 INCLINATION: -90
 WELL TAG: BKH 464

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft ◆				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30	40	GRAPHIC	
					DEPTH (Ft)						PL	MC	LL			
0	Rotasonic	0.0 - 2.0 FILL - MINE SPOILS, (GP-GM) GRAVEL, fine to coarse, some silt; brown; non-cohesive, moist, loose.			757.0									 <p style="font-size: small;">Depth to water at time of drilling</p>		
2.0		2.0 - 4.5 FILL - MINE SPOILS, (SM) SILTY SAND, some gravel, fine; dark brown to brown, thin laminations; non-cohesive, moist, compact.			754.5											
4.5		4.5 - 20.0 FILL - CEMENT KILN DUST, trace wood ash, trace coal fragments; light gray; non-cohesive, dry to moist, dense. 4.5 ft: Odor in core barrel, tested pH ~12 (mixture of DI water and soil)			739.0											
20		Boring completed at 20.0 ft.			20.0											

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016



RECORD OF BOREHOLE B-13

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/25/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 761
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 1.5 FILL - MINE SPOILS, (GP) GRAVEL, fine to coarse, some sand; brown, non-cohesive, moist, loose.	GP		759.5										
1.5		1.5 - 3.0 FILL - MINE SPOILS, (CL) CLAY, some sand, some silt, trace gravel, trace coal fragments; brown; cohesive, moist, stiff.	CL		758.0										
3.0		1.5 ft to 3 ft: Trace shale, coal tailings/fill													
5		3.0 - 10.0 FILL - CEMENT KILN DUST, some coal fragments; brown, mottled; non-cohesive, moist, dense.													
10		3 ft: Trace sandstone (fine grained), brown tailings/fill													
10		5 ft: pH ~12 (mixture of DI water and soil)													
10		10.0 - 20.0 FILL - CEMENT KILN DUST, trace coal fragments, trace wood fragments; gray; non-cohesive, moist, dense.			751.0										Backfilled with Medium (3/8") Bentonite Chips
20		Boring completed at 20.0 ft.			741.0										
20					20.0										

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016










RECORD OF BOREHOLE B-14

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/25/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 767
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 1.5 FILL - MINE SPOILS, (SP) SAND, some gravel, fine to coarse; brown to gray; non-cohesive, moist, loose.	SP		765.5 1.5									Backfilled with Medium (3/8") Bentonite Chips 	
		1.5 - 4.0 FILL - MINE SPOILS, (SM) SILTY SAND, fine, some gravel, trace coal fragments; brown to gray; non-cohesive, moist, dense.	SM		763.0 4.0										
		4.0 - 5.0 FILL - MINE SPOILS, (ML) Sandy SILT, some clay; brown mottled gray; cohesive, m < PL, stiff.	ML		762.0 5.0										
		5.0 - 8.5 FILL - CEMENT KILN DUST, trace clay, trace coal fragments; gray, non-cohesive, moist			758.5 8.5										
		8.5 - 11.0 FILL - MINE SPOILS, (SM) SILTY SAND, fine, trace coal fragments; orange-brown mottled gray, fine laminations; non-cohesive, moist, dense.			756.0 11.0										
		11.0 - 20.0 FILL - CEMENT KILN DUST; gray, fine laminations; non-cohesive, moist, dense.			747.0 20.0										
20		Boring completed at 20.0 ft.													

Depth to water at time of drilling

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016



RECORD OF BOREHOLE B-15

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotosonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/25/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: N: 126,528 E: 1,353,232

ELEVATION: 775.83
 INCLINATION: -90
 WELL TAG: BKH 465

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (Ft)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	PENETRATION RESISTANCE BLOWS / ft				GRAPHIC	
											10	20	30	40		
0	Rotosonic	0.0 - 2.0 FILL - MINE SPOILS, (GP) GRAVEL, fine to coarse, some sand; brownish-gray; non-cohesive, dry, loose.	GP	[Graphic: GP]	773.8											Flush Mount Monument Medium (3/8") Bentonite Seal, 2" Schedule 40 PVC Riser 10/20 Silica Sand 0.010-inch Slot Schedule 40 PVC Screen Depth to water at time of drilling
		2.0 - 4.0 FILL - MINE SPOILS, (SP) SAND, fine to medium, some gravel, fine; gray to brown; non-cohesive, moist, compact.	SP	[Graphic: SP]	771.8											
		4.0 - 5.0 FILL - MINE SPOILS, (ML) Sandy SILT, trace gravel, trace coal fragments; brown, mottled; cohesive, m < PL, very stiff.	ML	[Graphic: ML]	770.8											
5		5.0 - 7.0 FILL - MINE SPOILS, (SP) SAND, fine to coarse, trace silt, trace gravel; non-cohesive, moist, loose.	SP	[Graphic: SP]	768.8											
		7.0 - 10.0 FILL - MINE SPOILS, (SM) SILTY SAND, fine to medium, trace coal fragments, trace wood fragments; non-cohesive, moist, compact.	SM	[Graphic: SM]	765.8											
10		10.0 - 12.0 FILL - MINE SPOILS, (ML) Sandy SILT, trace coal fragments, trace fine gravel; olive gray mottled gray; cohesive, w < PL, stiff.	ML	[Graphic: ML]	763.8											
		12.0 - 13.0 FILL - MINE SPOILS, (ML) SILT, some sand, trace gravel; gray; cohesive, w < PL, firm.	ML	[Graphic: ML]	762.8											
		13.0 - 14.5 FILL - MINE SPOILS, (ML) Sandy SILT, trace gravel; orange-brown; cohesive, w < PL, firm.	ML	[Graphic: ML]	761.3											
15		14.5 - 15.0 FILL - CEMENT KILN DUST; gray; non-cohesive, moist, dense.		[Graphic: CKD]	760.8											
		Boring completed at 15.0 ft.														

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016



RECORD OF BOREHOLE B-16

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/26/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 781
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC		
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40	
					DEPTH (Ft)						PL	MC	LL			
0	Rotasonic	0.0 - 2.0 FILL - MINE SPOILS, (GP) GRAVEL, fine to coarse, some silt, trace cobble; brown; non-cohesive, moist, loose.	GP		779.0 2.0											
		2.0 - 5.0 FILL - MINE SPOILS, (SM) SILTY SAND, fine, some gravel, trace coal fragments, trace wood; gray to brown; non-cohesive, moist, compact.	SM		776.0 5.0											
5		5.0 - 10.0 FILL - MINE SPOILS, (SM) SILTY SAND, some coal fragments, trace gravel; dark brown mottled black; non-cohesive, moist, compact.	SM		771.0 10.0											
		10.0 - 12.0 FILL - MINE SPOILS, (ML) Sandy SILT; dark brown mottled brown, fine laminations; cohesive, m < PL, soft.	ML		769.0 12.0											
		12.0 - 13.0 FILL - MINE SPOILS, (ML) SILTY, trace fine sand; gray, cohesive, moist, very stiff.	ML		768.0 13.0											
		13.0 - 15.0 FILL - MINE SPOILS, (SM) SILTY SAND, trace gravel, trace coal fragments; dark gray mottled brown; non-cohesive, moist, compact.	SM		766.0 15.0											
		13 ft: pH 7 (mixture of DI water and soil)	ML		764.0 17.0											
		15.0 - 17.0 FILL - MINE SPOILS, (ML) Sandy SILT, some coal fragments, trace gravel; dark brownish-gray, cohesive, firm.	SP		762.0 19.0											
		17.0 - 19.0 FILL - MINE SPOILS, (SP) SAND, some silt, trace gravel, trace coal; orange-brown; non-cohesive, moist			761.0 20.0											
		19.0 - 20.0 FILL - CEMENT KILN DUST, trace coal fragments; gray; non-cohesive, moist	SM		759.0 22.0											
		20.0 - 22.0 FILL - MINE SPOILS, (SP-SM) SAND, some silt; brownish gray, musty odor; non-cohesive, wet, loose.			756.0 25.0											
		22.0 - 25.0 FILL - CEMENT KILN DUST, some silt, some sand, trace gravel; gray, finely laminated; non-cohesive, moist.			751.0 30.0											
		25.0 - 30.0 FILL - MINE SPOILS, (SM) SILTY SAND, trace gravel; fill debris (brick, asbestos); non-cohesive, moist, compact.	SM													
30			Boring completed at 30.0 ft.													

Backfilled with Medium (3/8") Bentonite Chips

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE 1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016



RECORD OF BOREHOLE B-17

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotosonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/26/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 792
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotosonic	0.0 - 5.0 FILL - MINE SPOILS, (GP) GRAVEL, fine to coarse, some sand, some silt, trace cobbles; brown to gray; non-cohesive, loose.	GP		787.0										
5		5.0 - 7.0 FILL - MINE SPOILS, (SM) SILTY SAND, fine, trace gravel; brown; non-cohesive, moist, loose.	SM		785.0										
		7.0 - 9.0 FILL - MINE SPOILS, (ML) Sandy SILT, trace gravel; dark brown mottled black; cohesive, firm.	ML		783.0										
		9.0 - 10.0 FILL - MINE SPOILS, (ML) SILT, trace sand; light gray; cohesive, m < PL, firm.	ML		782.0										
10		10.0 - 13.0 FILL - MINE SPOILS, (SP-SM) SAND, some silt, trace gravel; brown mottled gray; non-cohesive, compact	SP-SM		779.0										
		13.0 - 15.0 FILL - MINE SPOILS, (ML) SILT, some clay, trace sand, trace gravel; black to dark brown, finely laminated; cohesive, m < PL, stiff.	ML		777.0										
15		15.0 - 21.0 FILL - MINE SPOILS, (SM) SILTY SAND, trace gravel; dark brown; non-cohesive, moist, compact.	SM		15.0										
		15 ft to 20 ft: Water in core barrel above sample													
20		21.0 - 23.0 FILL - MINE SPOILS, (ML) Sandy SILT, some woody debris; brown mottled gray; non-cohesive, moist	ML		771.0										
		23.0 - 24.0 FILL - MINE SPOILS, (ML) SILT; gray; cohesive, firm.	ML		769.0										
		24.0 - 25.0 FILL - MINE SPOILS, (ML) SILT; black; cohesive, dry, soft.	ML		768.0										
25		24.0 - 25.0 FILL - MINE SPOILS, (ML) SILT; black; cohesive, dry, soft.	ML		24.0										
		25.0 - 29.0 (ML) Sandy SILT, trace gravel; reddish-brown, [BEDROCK?]; cohesive, w < PL, soft.			25.0										
		29.0 - 30.0 (ML) Sandy SILT, gray with black specks, [BEDROCK?]; cohesive, w < PL, soft.	ML		767.0										
30		29.0 - 30.0 (ML) Sandy SILT, gray with black specks, [BEDROCK?]; cohesive, w < PL, soft.	ML		29.0										
	29 ft: pH 7 (mixture of DI water and soil) Boring completed at 30.0 ft.	763.0													
				762.0											
				30.0											

Backfilled with Medium (3/8") Bentonite Chips

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE 1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016





RECORD OF BOREHOLE B-19

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotosonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/26/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 760
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0		0.0 - 2.0 FILL - MINE SPOILS, (ML) Sandy SILT, trace gravel; cohesive, moist, soft.	ML		758.0										
2.0		2.0 - 20.0 FILL - CEMENT KILN DUST, trace coal fragments; gray; non-cohesive, moist, dense.			2.0										
5	Rotosonic														
10		10 ft to 15 ft: Putrid odor													
15															
20		Boring completed at 20.0 ft.			740.0 20.0										
25															
30															
35															
40															

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

Backfilled with Medium (3/8") Bentonite Chips



Depth to water at time of drilling

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016




RECORD OF BOREHOLE B-19A

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/26/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 760
 INCLINATION: -60
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 1.0 FILL - MINE SPOILS, (ML) Sandy SILT; wet.	ML		759.1										Backfilled with Medium (3/8") Bentonite Chips
1.0		1.0 - 10.0 FILL - CEMENT KILN DUST, trace coal fragments, trace silt, trace clay; gray; non-cohesive, moist, dense.													
10		Boring completed at 10.0 ft.			751.3 10.0										
15															
20															
25															
30															
35															
40															

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016






RECORD OF BOREHOLE B-20

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 10/26/2016
 LOCATION: Access Rd East of LDA DRILL RIG: DB 360

DATUM: NAD 88
 COORDINATES: not surveyed

ELEVATION: 775
 INCLINATION: -80
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 10.0 FILL - MINE SPOILS, (CL) CLAY, some silt, trace sand; brown to dark brown; cohesive, moist. 1" cobble caught in bit	CL											Backfilled with Medium (3/8") Bentonite Chips	
5															
10		10.0 - 12.0 FILL - MINE SPOILS, (ML) CLAYEY SILT, trace sand, trace gravel; cohesive, moist, stiff.	ML		765.2 10.0										
15	12.0 - 20.0 FILL - CEMENT KILN DUST; gray; non-cohesive, moist, dense.			763.2 12.0											
20	Boring completed at 20.0 ft.				755.3 20.0										

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: S. Morgan
 DATE: 11/21/2016



RECORD OF BOREHOLE B-21

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension	DRILLING METHOD: Rotosonic	DATUM: NAD 88	ELEVATION: 783.25
PROJECT NUMBER: 1520304-01	DRILLING DATE: 12/11/2017	COORDINATES: N: 126,239 E: 1,353,336	INCLINATION: -90
LOCATION: Access Rd East of LDA	DRILL RIG: Terrasonic 150		WELL TAG: BKH 466

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30	40	GRAPHIC
					DEPTH (Ft)						PL	MC	LL		
0	Rotosonic	0.0 - 1.0 Silty SAND (SM), Fine to Medium Sand, Few 6" Cobbles, Brown, Loose, Moist	SM		782.3									<p style="font-size: small;">11.21' DTW after drilling</p>	
1.0		1.0 - 8.0 Silty SAND (SM), Fine to Medium Sand, Trace Fine to Coarse Gravel, Brown, Compact, Moist	SM		775.3										
8.0		8.0 - 13.0 Clayey SAND (SC), Fine to Medium Sand, Some Silt, Trace Fine Gravel, Brown, Compact, Moist -Becomes Wet	SC		770.3										
13.0		13.0 - 20.0 SANDSTONE, Fine-grained with Silt, Weathered, Weak, Orange/Gray Mottled, Dry to Moist, Driller Note: Tough drilling at 13'	Sandstone		763.3										
20.0		Boring completed at 20.0 ft.			20.0										

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



RECORD OF BOREHOLE B-22

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 12/12/2017
 LOCATION: Access Rd East of LDA DRILL RIG: Terrasonic 150

DATUM: NAD 88
 COORDINATES: N: 126,280 E: 1,353,344

ELEVATION: 788.36
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 2.0 Silty SAND (SM), Fine to Coarse Sand, Trace Fine Gravel, Dark Brown, Loose, Moist	SM		786.4										
2.0 - 11.0		Silty SAND (SM), Fine Sand, Some Fine to Coarse Gravel, Rounded, Trace Cobbles, Trace Charcoal, Brown, Loose, Moist	SM		2.0										
11.0 - 20.0		- becomes wet Fine Grained SANDSTONE, Some Silt, Weathered, Weak, Yellowish Brown, Moist	Sandstone		777.4										
20.0		- reddish-yellow, yellowish-brown, light gray mottled	Sandstone		11.0										
20.0		Boring completed at 20.0 ft.			768.4										
20.0					20.0										

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

Backfilled with
Medium (3/8")
Bentonite
Chips

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



RECORD OF BOREHOLE B-23

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 12/11/2017
 LOCATION: Access Rd East of LDA DRILL RIG: Terrasonic 150

DATUM: NAD 88
 COORDINATES: N: 126,387 E: 1,353,381

ELEVATION: 809.41
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 5.0 Silty SAND (SM), Fine to Coarse Sand, Some Fine Gravel, Compact, Dark Brown, Moist	SM		804.4									Backfilled with Medium (3/8") Bentonite Chips	
5		5.0 - 10.0 Sandy SILT (ML), Fine to Coarse Sand, Some Fine to Coarse Gravel, Brown, Firm to Stiff, Moist	ML		5.0										
		8.5 - 9.5 - wood fragments			799.4										
10		10.0 - 11.5 Silty SAND (SM), Fine to Medium Sand, Trace Fine Gravel, Roots, Compact, Brown, Gray, Wet	SM		10.0										
		11.5 - 16.0 CLAY (CL), Blocky, Yellowish-Brown/Gray Mottled, Stiff, Dry	CL		11.5										
15		15.0 - 16.0 - increase Sand			793.4										
		16.0 - 19.0 COAL, Weak, Black, Dry	COAL		16.0										
20		19.0 - 21.0 CLAY (CL), Some Coal, Laminated, Yellowish-Brown, Stiff, Dry	CL		19.0										
		21.0 - 25.0 COAL, Weak, Black, Dry	COAL		21.0										
25			Boring completed at 25.0 ft.		784.4										
25.0				25.0											

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE 1.0_DATA_TEMPLATE.GDT 4/10/18

18 95 DTW after drilling on 12/12/17

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



RECORD OF BOREHOLE B-24

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 12/11/2017
 LOCATION: Access Rd East of LDA DRILL RIG: Terrasonic 150

DATUM: NAD 88
 COORDINATES: N: 126,464 E: 1,353,353

ELEVATION: 810.03
 INCLINATION: -90
 WELL TAG: BKH 467

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 10.0 Silty SAND (SM), Fine to Medium Sand, Some Fine Gravel, Trace Clay, Brown to Dark Brown, Compact, Moist	SM											Flush Mount Monument Medium (3/8") Bentonite Seal, 2" Schedule 40 PVC Riser 10/20 Silica Sand 0.010-inch Slot Schedule 40 PVC Screen 9.9" DIW After well installation	
5															
10		-Trace Coal Clasts 10.0 - 12.0 Silty SAND (SM), Fine to Medium Sand, Trace Fine Gravel, Dark Gray, Loose, Moist to Wet	SM		800.0										
12.0		12.0 - 15.0 Poorly Graded SAND (SP), Some Silt, Yellowish Brown/Light Gray Mottled, Wet	SP		798.0										
15		15.0 - 20.0 Fine grained SANDSTONE, Weathered, Yellowish Brown/Light Gray Mottled, Weak, Moist	SS		795.0										
20		Boring completed at 20.0 ft.		790.0											
20.0				20.0											
25															
30															
35															
40															

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE_1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



RECORD OF BOREHOLE B-25

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotasonic DATUM: NAD 88 ELEVATION: 807.10
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 12/11/2017 COORDINATES: N: 126,546 E: 1,353,359 INCLINATION: -90
 LOCATION: Access Rd East of LDA DRILL RIG: Terrasonic 150 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotasonic	0.0 - 3.0 Silty SAND (SM), Fine to Coarse Sand, some Fine Gravel, Dark Gray, Compact, Dry	SM		804.1									Backfilled with Medium (3/8") Bentonite Chips	
3.0 - 7.5		ML		799.6											
7.5 - 18.0		COAL		789.1											
18.0 - 23.0		Shale		784.1											
23.0 - 25.0		Shale		782.1											
25.0		Boring completed at 25.0 ft.													

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE 1.0_DATA_TEMPLATE.GDT 4/10/18

23.6 DTW After Drilling on
12/12/17

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



RECORD OF BOREHOLE B-26

SHEET 1 of 1

PROJECT: Ravensdale Trench Extension DRILLING METHOD: Rotosonic
 PROJECT NUMBER: 1520304-01 DRILLING DATE: 12/12/2017
 LOCATION: Access Rd East of LDA DRILL RIG: Terrasonic 150

DATUM: NAD 88
 COORDINATES: N: 126,616 E: 1,353,348

ELEVATION: 804.08
 INCLINATION: -90
 WELL TAG:

DEPTH (Ft)	BORING METHOD	SOIL PROFILE				SAMPLES				PENETRATION RESISTANCE BLOWS / ft				NOTES WATER LEVELS GRAPHIC	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC ATT	10	20	30		40
					DEPTH (Ft)						PL	MC	LL		
0	Rotosonic	0.0 - 2.0 Silty SAND (SM), Fine to Coarse Sand, Trace Gravel, Brown/Black/Gray Mottled, Loose, Moist	SM	[Pattern]	802.1									Backfilled with Medium (3/8") Bentonite Chips	
		2.0 - 5.0 Poorly Graded SAND with Silt (SP-SM), Fine Sand, Gray to Light Gray, Loose, Moist-Wet	SP-SM	[Pattern]	2.0										
5		5.0 - 8.0 SILT (ML), Fine Laminations, Light Gray, Dry	ML	[Pattern]	799.1										
		7.0 - 8.0 pH 7- 8			796.1										
		8.0 - 25.0 SILTSTONE, Trace Fine Sand, Laminated, <2mm Coal Beds, Gray, Dark Gray, Very Stiff, Dry	SILTSTONE	[Pattern]	8.0										
15		-Increase Shale, Trace Coal, Tight Drilling													
20	-becomes Hard														
25	-Increase thickness of silt beds														
		Boring completed at 25.0 ft.			779.1										
					25.0										

22.00 DTW after drilling on 12/12/17

RECORD OF BOREHOLE 15-20304 HOLCIM RAVENSDALE BOREHOLE LOGS.GPJ SPARKLE 1.0_DATA_TEMPLATE.GDT 4/10/18

1 in to 5 ft
 DRILLING CONTRACTOR: Cascade Drilling
 DRILLER: D. Rider

LOGGED: J. Miller
 CHECKED: G. Zimmerman
 DATE: 4/5/2018



Coarse-Grained Soils - More than 50% (1) Retained on No. 200 Sieve		Terms Describing Relative Density and Consistency																							
Gravels - More than 50% (1) of Coarse Fraction Retained on No. 4 Sieve		GW	Well-graded gravel and gravel with sand, little to no fines																						
		GP	Poorly-graded gravel and gravel with sand, little to no fines																						
		GM	Silty gravel and silty gravel with sand																						
		GC	Clayey gravel and clayey gravel with sand																						
		SW	Well-graded sand and sand with gravel, little to no fines																						
		SP	Poorly-graded sand and sand with gravel, little to no fines																						
Sands - 50% (1) or More of Coarse Fraction Passes No. 4 Sieve		SM	Silty sand and silty sand with gravel																						
		SC	Clayey sand and clayey sand with gravel																						
		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel																						
Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve	Sils and Clays Liquid Limit Less than 50	CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay																						
		OL	Organic clay or silt of low plasticity																						
		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt																						
	Sils and Clays Liquid Limit 50 or More	CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel																						
		OH	Organic clay or silt of medium to high plasticity																						
		PT	Peat, muck and other highly organic soils																						
Highly Organic Soils		PT	Peat, muck and other highly organic soils																						
		<p>Density</p> <table border="0"> <tr><td>Very Loose</td><td>0 to 4</td></tr> <tr><td>Loose</td><td>4 to 10</td></tr> <tr><td>Medium Dense</td><td>10 to 30</td></tr> <tr><td>Dense</td><td>30 to 50</td></tr> <tr><td>Very Dense</td><td>>50</td></tr> </table> <p>Consistency</p> <table border="0"> <tr><td>Very Soft</td><td>0 to 2</td></tr> <tr><td>Soft</td><td>2 to 4</td></tr> <tr><td>Medium Stiff</td><td>4 to 8</td></tr> <tr><td>Stiff</td><td>8 to 15</td></tr> <tr><td>Very Stiff</td><td>15 to 30</td></tr> <tr><td>Hard</td><td>>30</td></tr> </table> <p>Test Symbols</p> <p>FC = Fines Content GS = Grain Size MC = Moisture Content AL = Atterberg Limits C = Consolidation DD = Dry Density K = Permeability Str = Shear Strength Env = Environmental PID = Photoionization Detector</p>		Very Loose	0 to 4	Loose	4 to 10	Medium Dense	10 to 30	Dense	30 to 50	Very Dense	>50	Very Soft	0 to 2	Soft	2 to 4	Medium Stiff	4 to 8	Stiff	8 to 15	Very Stiff	15 to 30	Hard	>30
Very Loose	0 to 4																								
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		<p>Component Definitions</p> <table border="0"> <thead> <tr> <th>Descriptive Term</th> <th>Size Range and Sieve Number</th> </tr> </thead> <tbody> <tr><td>Boulders</td><td>Larger than 12"</td></tr> <tr><td>Cobbles</td><td>3" to 12"</td></tr> <tr><td>Gravel</td><td>3" to No. 4 (4.75 mm)</td></tr> <tr><td> Coarse Gravel</td><td>3" to 3/4"</td></tr> <tr><td> Fine Gravel</td><td>3/4" to No. 4 (4.75 mm)</td></tr> <tr><td>Sand</td><td>No. 4 (4.75 mm) to No. 200 (0.075 mm)</td></tr> <tr><td> Coarse Sand</td><td>No. 4 (4.75 mm) to No. 10 (2.00 mm)</td></tr> <tr><td> Medium Sand</td><td>No. 10 (2.00 mm) to No. 40 (0.425 mm)</td></tr> <tr><td> Fine Sand</td><td>No. 40 (0.425 mm) to No. 200 (0.075 mm)</td></tr> <tr><td>Silt and Clay</td><td>Smaller than No. 200 (0.075 mm)</td></tr> </tbody> </table>		Descriptive Term	Size Range and Sieve Number	Boulders	Larger than 12"	Cobbles	3" to 12"	Gravel	3" to No. 4 (4.75 mm)	Coarse Gravel	3" to 3/4"	Fine Gravel	3/4" to No. 4 (4.75 mm)	Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)	Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)	Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)	Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)	Silt and Clay	Smaller than No. 200 (0.075 mm)
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		<p>(3) Estimated Percentage</p> <table border="0"> <thead> <tr> <th>Percentage by Weight</th> <th>Modifier</th> </tr> </thead> <tbody> <tr><td><5</td><td>Trace</td></tr> <tr><td>5 to 15</td><td>Slightly (sandy, silty, clayey, gravelly)</td></tr> <tr><td>15 to 30</td><td>Sandy, silty, clayey, gravelly</td></tr> <tr><td>30 to 49</td><td>Very (sandy, silty, clayey, gravelly)</td></tr> </tbody> </table> <p>Moisture Content</p> <p>Dry - Absence of moisture, dusty, dry to the touch Slightly Moist - Perceptible moisture Moist - Damp but no visible water Very Moist - Water visible but not free draining Wet - Visible free water, usually from below water table</p>		Percentage by Weight	Modifier	<5	Trace	5 to 15	Slightly (sandy, silty, clayey, gravelly)	15 to 30	Sandy, silty, clayey, gravelly	30 to 49	Very (sandy, silty, clayey, gravelly)												
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		<p>Symbols</p> <p>Blows/6" or portion of 6"</p> <p>2.0" OD Split-Spoon Sampler (SPT)</p> <p>Continuous Push</p> <p>Non-Standard Sampler</p> <p>3.0" OD Thin-Wall Tube Sampler (including Shelby tube)</p> <p>Grab Sample</p> <p>Portion not recovered</p> <p>Cement grout surface seal</p> <p>Bentonite chips</p> <p>Grout seal</p> <p>Filter pack with blank casing section</p> <p>Screened casing or Hydrotrip with filter pack</p> <p>Grouted Transducer</p> <p>End cap</p>																							
		<p>(1) Percentage by dry weight (2) (SPT) Standard Penetration Test (ASTM D-1586) (3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488) (4) Depth of groundwater ∇ ATD = At time of drilling BGS = below ground surface ∟ Static water level (date)</p> <p>(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)</p>																							

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
 28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
 E side of road

Coordinates (est)
 E:1352855 N:127898 (est)

Exploration Number

AB-05

Contractor
 Holocene Drilling

Equipment
 Rotary drill rig

Sampling Method
 Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
 702.6296' (est)

Operator
 Keven Doyle

Exploration Method(s)
 8.5-in OD Hollow-stem Auger

Work Start/Completion Dates
 5/15/2017

Top of Casing Elev. (NAVD88)
 NA

Depth to Water (Below GS)
 6' (ATD)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
700					PID= 0.2 Blows (non-SPT)= 27,39,20 Sheen= Slight		FILL Dense, moist, brown, slightly silty SAND (SW-SM); fine to coarse gravel, medium to coarse sand, with brick fragments, slight odor of mothballs	
					PID= 0.0 SPT= 6,6,6 Sheen= None			
					PID= 4.4 Blows (non-SPT)= 3,5,9 Sheen= Slight		Bits of charcoal; no more coarse gravel	
5		5/15/2017			PID= 0.1 SPT= 11,6,7 Sheen= None		Dense, moist, brown, gravelly silty SAND (SM); subrounded gravel	5
					PID= 0.1 Blows (non-SPT)= 9,12,19 Sheen= None		Dense, moist, brown, gravelly, sandy SILT (ML); pockets of iron-oxide weathering	
		Backfilled with hydrated bentonite chips			Blows (non-SPT)= 50/6"		Hard, wet, brown-gray, slightly gravelly silty SAND (SM); fine to medium sand	
10			AB-05-9.0	Total Pb, Total As, SPLP Pb, SPLP As	PID= 0.1 Blows (non-SPT)= 47,50/3" Sheen= None PID= 0.1 SPT= 50/4"		Dense, wet to moist, brown, gravelly, sandy SILT (ML)	10
							Bottom of exploration at 10.5 ft. bgs. Note: Refusal on bedrock or concrete at 10.5' bgs	
690								
15								
685								
20								
680								

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: KB
 Approved by: CEB 6/1/2017

Exploration Log
AB-05

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
E side of road

Coordinates (est)
E:1352875 N:127789 (est)

Exploration Number

AB-06

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
709.4823'(est)

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem Auger

Work Start/Completion Dates
5/15/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
7.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
705			AB-06-1.5	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 39,41,22 PID= 0.2 Sheen= None		FILL Dense, moist, brown, gravelly, silty slightly silty SAND (SW-SM) interbedded with sandy SILT (ML); with brick and coal fragments	
5					PID= 0.2 SPT= 6,12,14 Sheen= Slight			
					PID= 0.2 Blows (non-SPT)= 12,14,8 Sheen= Slight			
					PID= 0.2 SPT= 5,1,1 Sheen= Organic		Soft, moist, brown, sandy SILT (ML); abundant organics, with coal and charcoal fragments, trace fine gravel	5
					PID= 0.2 Blows (non-SPT)= 1,2,6 Sheen= Organic		Medium dense, moist, brown, gravelly silty SAND (SM); pockets of iron-oxide weathering, fine to coarse gravel	
10					PID= 0.2 Blows (non-SPT)= 2,12,14 Sheen= Organic			
					PID= 0.2 Blows (non-SPT)= 7,8,13 Sheen= None		Hard, moist to wet, brown-orange gravelly, sandy SILT (ML); pockets of iron-oxide weathering, fine to coarse subrounded gravel, medium to coarse sand	10
					PID= 0.2 SPT= 14,48,50 Sheen= None			
					PID= 0.2 Blows (non-SPT)= 50/4" Sheen= None		Dense, moist, brown, gravelly, silty SAND (SM); fine to coarse gravel, medium to coarse sand, with brick and coal fragments	
					PID= 0.2 SPT= 50/5" Sheen= Slight		GLACIAL TILL Dense, moist, dark gray silty SAND (SM); medium to coarse sand, trace fine gravel	15
					PID= 0.2 SPT= 28,50/1"		Dense, moist, dark gray, gravelly silty SAND (SM); fine to coarse gravel, medium to coarse sand	
					Blows (non-SPT)= 25,50/5"			
							Bottom of exploration at 17.8 ft. bgs. Note: pH of groundwater grab sample =7.58	
695			AB-06-14.0	Total Pb, Total As, SPLP Pb, SPLP As				
15								
690								
20								
685								

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-06

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
 28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
 E side of road

Coordinates (est)
 E:1352896 N:127651 (est)

Exploration Number

AB-07

Contractor
 Holocene Drilling

Equipment
 Rotary drill rig

Sampling Method
 Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
 717.6884'(est)

Operator
 Keven Doyle

Exploration Method(s)
 8.5-in OD Hollow-stem Auger

Work Start/Completion Dates
 5/15/2017

Top of Casing Elev. (NAVD88)
 NA

Depth to Water (Below GS)
 11.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
715			AB-07-1.5	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 38,22,29 PID= 0.1 Sheen= None SPT= 26,11,6 PID= 0.2 Sheen= None		FILL Dense, moist, brown, gravelly slightly silty SAND (SW-SM); fine to coarse gravel, some cement kiln dust, fine gravel-sized slag	
5					Blows (non-SPT)= 9,11,8 PID= 0.2 Sheen= None SPT= 2,3,3 PID= 0.2 Sheen= None		Medium dense, moist, orange-yellow, slightly silty SAND (SP); charcoal fragments, medium to coarse sand	5
710					Blows (non-SPT)= 3,5,6 PID= 0.2 Sheen= None		Contains some coarse, subrounded gravel	
10		Backfilled with hydrated bentonite chips ▽ 5/15/2017			Blows (non-SPT)= 2,3,4 PID= 0.2 Sheen= None SPT= 2,3,5 PID= 0.2 Sheen= None		Interbedded coarse white sand	10
705					SPT= 4,3,4 PID= 0.2 Sheen= None		Abundant woody debris Soft, moist, green-brown, slightly gravelly, silty SAND (SM); subrounded, fine gravel	
15					Blows (non-SPT)= 5,9,18 PID= 0.2 Sheen= None PID= 0.2 Sheen= None		Dense, moist, orange-brown, sandy SILT (ML); pockets of iron-oxide weathering, coal fragments	15
700					Blows (non-SPT)= 9,18,32			
20							Bottom of exploration at 18 ft. bgs. Note: pH of groundwater grab sample =6.79	20
695								

ASPECT STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\RESERVE SILICA- 160315.GPJ November 9, 2017

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- ▣ Split Barrel 2" X 1.375" (SPT)

Water Level

▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: KB
 Approved by: CEB 6/1/2017

Exploration Log
AB-07

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
W side of road

Coordinates (est)
E:1352874 N:127517 (est)

Exploration Number

AB-08

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
723.6216'(est)

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem
Auger

Work Start/Completion Dates
5/15/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
720			AB-08-1.5	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 15, 17, 15 PID= 0.2 Sheen= None SPT= 10, 9, 6 PID= 0.2 Sheen= None SPT= 5, 5, 5 PID= 0.2 Sheen= None		FILL Dense, moist, brown, gravelly, slightly silty SAND (SW-SM); fine to coarse gravel, fine, medium, and coarse sand, gravel-sized slag fragments Medium dense, moist, orange-beige slightly silty SAND (SP); medium to coarse sand, trace fine gravel, trace woody debris and coal fragments	5
715			AB-08-7.5	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 5, 5, 5 PID= 0.2 Sheen= None Blows (non-SPT)= 6, 8, 9 PID= 0.2 Sheen= None SPT= 2, 3, 4 PID= 0.2 Sheen= None SPT= 2, 3, 3 PID= 0.2 Sheen= None		Medium dense, moist, orange-brown silty SAND (SM); abundant coal fragments Medium dense, moist, orange-beige slightly silty SAND (SP); medium to coarse sand, trace fine gravel, trace woody debris and coal fragments	10
710			AB-08-11.5		Blows (non-SPT)= 4, 4, 4 PID= 0.2 Sheen= None SPT= 3, 3, 2 PID= 0.2 Sheen= None SPT= 2, 2, 2 PID= 0.2 Sheen= None		Medium dense, moist, green-brown silty SAND (SM); abundant woody debris, coal fragments, and brick fragments Abundant coal fragments Becomes more organic-rich	15
705			AB-08-18.0		PID= 0.2 Sheen= Organic		Bottom of exploration at 19.5 ft. bgs.	20

Backfilled with hydrated bentonite chips

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-08

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
center of road

Coordinates (est)
E:1352887 N:127413 (est)

Exploration Number

AB-09

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
724.8403'(est)

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem
Auger

Work Start/Completion Dates
5/16/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
12.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
			AB-09-1.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 48,28,27 PID= 0.1 Sheen= None		FILL Dense, moist, gray-brown, silty, sandy slightly silty GRAVEL (GP-GM); fine to coarse gravel, medium to coarse sand	
			AB-09-3.0		SPT= 16,11,17 PID= 0.3 Sheen= None		Dense, moist, orange, slightly silty, gravelly SAND (SW); fine to coarse gravel, fine gravel-sized slag, medium to coarse sand	
			AB-09-5.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 5,7,11 PID= 30.7 Sheen= Slight			
5	720				Blows (non-SPT)= 19,27,27 PID= 0.5 Sheen= None		Loose, moist, white SAND (SP); coarse sand, strong odor of mothballs, coal fragments	5
					Blows (non-SPT)= 10,11,5 PID= 0.4 Sheen= None		Dense, moist, gray-brown sandy, silty GRAVEL (GM) interbedded with loose, moist, orange and white SAND (SP); coal fragments	
					SPT= 4,4,4 PID= 0.4 Sheen= None		Loose, moist, yellow-gray silty SAND (SM); medium to coarse sand	
10	715	Backfilled with hydrated bentonite chips			SPT= 8,9,10 PID= 0.4 Sheen= None		Interbeds of white coarse sand, small bits of coal	10
		▽ 5/15/2017			Blows (non-SPT)= 5,6,9 PID= 0.4 Sheen= None			
					SPT= 2,2,2 PID= 0.3 Sheen= None		Loose, wet, yellow-brown silty SAND (SM) interbedded with medium dense, wet, yellow, organic-rich SAND (SP); fine to medium sand, coal fragments and wood debris, exhibits rapid dilatency	
15	710				SPT= 1,1,1 PID= 0.3 Sheen= None			15
					Blows (non-SPT)= 1,1,1 PID= 0.3 Sheen= None		QUATERNARY WETLAND Very soft, wet, brown silty SAND (SM); organic-rich, fine to medium sand	
					SPT= 1,1,1 PID= 0.3 Sheen= None			
			AB-09-18.0		SPT= 1,1,2 PID= 0.3 Sheen= None		Very soft, wet, brown PEAT (PT); fine to medium sand	
20	705						Bottom of exploration at 19.5 ft. bgs.	20

ASPECT STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\RESERVE SILICA- 160315.GPJ November 9, 2017

Legend

- ☐ No Soil Sample Recovery
- ▨ Split Barrel 3" X 2.375" (Mod Cal)
- ▩ Split Barrel 2" X 1.375" (SPT)
- ▧ Split Barrel 3.25" X 2.375" (D&M)

Water Level

▽ Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-09

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
center E of road

Coordinates (est)
E:1352892 N:127284 (est)

Exploration Number

AB-10

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
731.2477'(est)

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem
Auger

Work Start/Completion Dates
5/16/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
9' (ATD)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
730			AB-10-1.5		Blows (non-SPT)= 48,42,47 PID= 0.3 Sheen= None		FILL Dense, moist, gray, gravelly, silty slightly silty SAND (SW-SM); gravel-sized slag fragments	
					SPT= 12,10,9 PID= 0.3 Sheen= None		Medium dense, moist, orange, gravelly, silty SAND (SP) interbedded with white SAND (SP); fine to coarse gravel, with sandstone gravel	
5			AB-10-5.0		Blows (non-SPT)= 5,5,9 PID= 0.3 Sheen= Slight			5
					Blows (non-SPT)= 6,6,7 PID= 3.3 Sheen= Slight			
725					Blows (non-SPT)= 4,6,7 PID= 0.3 Sheen= None			
					SPT= 3,2,3 PID= 0.4 Sheen= Slight			
10		5/15/2017 Backfilled with hydrated bentonite chips	AB-10-10.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 2,3,2 PID= 0.4 Sheen= None		Medium dense, moist, gray, slightly gravelly silty SAND (SM); abundant coal fragments, fine, medium, and coarse sand, fining downward	10
720					SPT= 2,3,5 PID= 0.4 Sheen= None			
					Blows (non-SPT)= 9,8,12 PID= 0.4 Sheen= None		Medium dense, moist, gray SAND (SP); clean with coal fragments	
					Blows (non-SPT)= 4,10,12 PID= 0.4 Sheen= None		Medium dense, moist, gray, slightly gravelly silty SAND (SM); abundant coal fragments, fine, medium, and coarse sand, fining downward	
15					SPT= 12,11,11 PID= 0.4 Sheen= None		Dense, moist, orange-beige, silty SAND (SM) interbedded with white SAND (SP); coal fragments, medium to coarse sand	15
715					Blows (non-SPT)= 8,10,11 PID= 0.4 Sheen= None		Brick and coal fragments	
					Blows (non-SPT)= 2,5,6 PID= 0.4 Sheen= None			
20			AB-10-18.0				Bottom of exploration at 19.5 ft. bgs.	20
710								

ASPECT STANDARD EXPLORATION LOG TEMPLATE P:\GINTW\PROJECTS\RESERVE SILICA- 160315.GPJ November 9, 2017

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)
- Split Barrel 3.25" X 2.375" (D&M)

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-10

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road; center W of road

Coordinates (est)
E:1352881 N:127169 (est)
Ground Surface (GS) Elev. (NAVD88)
731.1889'(est)

Exploration Number
AB-11

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem Auger

Work Start/Completion Dates
5/16/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
19' (Static)

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
730			AB-11-1.5	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 32,36,27 PID= 0.3 Sheen= None		FILL Dense, moist, gray-brown, silty, sandy GRAVEL (GW); includes coarse gravel-sized slag, mixed with coal fragments and some orange sand	
					Blows (non-SPT)= 14,12,8 PID= 0.3 Sheen= None		Medium dense, moist, orange slightly silty SAND (SP) interbedded with white SAND (SP); trace fine gravel, medium to coarse sand	
					Blows (non-SPT)= 7,7,4 PID= 0.3 Sheen= Organic		Soft, moist, black, silty SAND (SM); primarily coal fragments, trace fine gravel	
5			AB-11-5.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 42,22,27 PID= 0.3 Sheen= Organic		Dense, moist, gray-black silty SAND (SM) interbedded with orange SAND (SP); mixture of slag fragments and coal fragments	5
					Blows (non-SPT)= 6,8,9 PID= 0.3 Sheen= None		Medium dense, moist, orange, slightly silty SAND (SP) interbedded with white SAND (SP); coal fragments	
					Blows (non-SPT)= 9,7,22 PID= 0.3 Sheen= None		Interbedded white sand up to 4" thick Interbedded coal up to 6" thick	
10		Backfilled with hydrated bentonite chips	AB-11-10.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 48,42,12 PID= 0.3 Sheen= None		Interbedded cement kiln dust up to 4" thick	10
					Blows (non-SPT)= 15,13,10 PID= 0.3 Sheen= None			
					Blows (non-SPT)= 1,2,2 PID= 0.3 Sheen= None			
					Blows (non-SPT)= 4,9,16 PID= 0.3 Sheen= Organic		Medium dense, moist, orange SAND (SP) interbedded with gray SILT (ML); trace coarse gravel, coal fragments	
15			AB-11-15.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 9,16,12 PID= 0.3 Sheen= None			15
					Blows (non-SPT)= 8,12,10 PID= 0.3 Sheen= None			
					Blows (non-SPT)= 4,7,10 PID= 0.3 Sheen= None			
20			AB-11-18.0				Bottom of exploration at 19.5 ft. bgs. Note: pH of groundwater grab sample =12.67	20
710								

ASPECT STANDARD EXPLORATION LOG TEMPLATE P:\GINTWPROJECTS\RESERVE SILICA- 160315.GPJ November 9, 2017

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)
- Split Barrel 3.25" X 2.375" (D&M)

Water Level

Static Water Level

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-11

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Environmental Exploration Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Haul road;
W side of road by pullout

Coordinates (est)
E:1352878 N:127048 (est)

Exploration Number

AB-12

Contractor
Holocene Drilling

Equipment
Rotary drill rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface (GS) Elev. (NAVD88)
741.7656'(est)

Operator
Keven Doyle

Exploration Method(s)
8.5-in OD Hollow-stem Auger

Work Start/Completion Dates
5/16/2017

Top of Casing Elev. (NAVD88)
NA

Depth to Water (Below GS)
No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
740			AB-12-1.0	Total Pb, Total As, SPLP Pb, SPLP As	Blows (non-SPT)= 48,39,28 PID= 0.4 Sheen= None SPT= 13,11,11 PID= 0.4 Sheen= None		FILL Dense, moist, brown slightly silty GRAVEL (GP-GM) Dense, moist, black, silty SAND (SM); contains bits of slag, coal, and sandstone	
5			AB-12-5.0	Total Pb, Total As, SPLP Pb, SPLP As	SPT= 6,10,6 PID= 0.4 Sheen= None Blows (non-SPT)= 2,6,10 PID= 0.4 Sheen= None SPT= 3,6,10 PID= 0.4 Sheen= None		Soft, dry, white Fill; cement kiln dust Dense, moist, black, silty SAND (SM); contains bits of slag, coal, and sandstone Medium dense, moist, orange, slightly silty SAND (SP) interbedded with coarse, white SAND (SP); bits of coal	5
735			AB-12-10.0		SPT= 2,4,5 PID= 0.4 Sheen= None Blows (non-SPT)= 9,7,10 PID= 0.4 Sheen= Organic		Some interbeds of gray, silty sand with wood fragments Loose, moist, brownish-black WOODY DEBRIS Fill	10
10		Backfilled with hydrated bentonite chips	AB-12-13.0		SPT= 5,10,13 PID= 0.4 Sheen= Organic SPT= 3,5,6 PID= 0.4 Sheen= Organic			
730			AB-12-18.0		Blows (non-SPT)= 9,9,12 PID= 2.1 Sheen= Organic SPT= 6,6,5 PID= 8.4 Sheen= Organic SPT= 4,5,6 PID= 4.8 Sheen= Organic			15
15					Blows (non-SPT)= 5,6,5 PID= 9.1 Sheen= Organic			20
725							Bottom of exploration at 19.5 ft. bgs.	
20								
720								

Legend

- No Soil Sample Recovery
- Split Barrel 3" X 2.375" (Mod Cal)
- Split Barrel 2" X 1.375" (SPT)
- Split Barrel 3.25" X 2.375" (D&M)

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by: CEB 6/1/2017

Exploration Log
AB-12

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Excavation Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, Near haul road

Coordinates (Lat, Lon WGS84)
47.342, -121.993 (est)

Exploration Number

ATP-1

Contractor

N/A

Equipment

Excavator

Sampling Method

Grab

Ground Surface (GS) Elev.

NA

Operator

Dean

Exploration Method(s)

Test Pit

Work Start/Completion Dates

4/5/2018

Top of Casing Elev.

NA

Depth to Water (Below GS)

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1		Backfilled with spoils					<p>FILL</p> <p>Moist, gray, gravelly, silty SAND (SM); fine to medium sand, fine gravel.</p>	1
2				ATP-1-Slag High pH Leachable Pb, As, Fe, Mn			Increased slag fragments between 1 and 3 feet bgs.	2
3							Bottom of exploration at 3 ft. bgs. Note: Test pit terminated at refusal.	3
4								4

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by:

Exploration Log ATP-1

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Excavation Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, W side of haul road near bascourse pile

Coordinates (Lat, Lon WGS84)
47.344, -121.993 (est)

Exploration Number

ATP-2

Contractor

N/A

Equipment

Excavator

Sampling Method

Grab

Ground Surface (GS) Elev.

NA

Operator

Dean

Exploration Method(s)

Test Pit

Work Start/Completion Dates

4/5/2018

Top of Casing Elev.

NA

Depth to Water (Below GS)

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1		Backfilled with spoils					<p>FILL Moist, gray, sandy GRAVEL (GP); fine to coarse sand, fine angular gravel; (road basecourse).</p>	1
2								2
3							<p>Moist, yellow-orange, silty SAND (SM); fine to coarse sand, with charcoal and slag fragments.</p>	3
4					4			
5				ATP-2-Slag High pH Leachable Pb, As			<p>Moist, gray, Fill; bricks, concrete, plastic debris.</p>	5
								Bottom of exploration at 5.5 ft. bgs.

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by:

Exploration Log ATP-2

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Excavation Log

Project Address & Site Specific Location
28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, E side of haul road

Coordinates (Lat,Lon WGS84)
47.343, -121.993 (est)

Exploration Number

ATP-3

Contractor

N/A

Equipment

Excavator

Sampling Method

Grab

Ground Surface (GS) Elev.

NA

Operator

Dean

Exploration Method(s)

Test Pit

Work Start/Completion Dates

4/5/2018

Top of Casing Elev.

NA

Depth to Water (Below GS)

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1		Backfilled with spoils					FILL Moist, gray, sandy GRAVEL (GP); fine to coarse sand, fine angular gravel, (road basecourse).	1
2				ATP-3-Slag High pH Leachable Pb, As, Fe, Mn			Moist, yellow-orange, silty SAND (SM); fine to coarse sand, with charcoal and slag fragments.	2
3								3
4							Bottom of exploration at 4 ft. bgs.	4

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
Approved by:

Exploration Log ATP-3

Sheet 1 of 1



Reserve Silica--Ravensdale - 160315

Excavation Log

Project Address & Site Specific Location
 28131 Ravensdale-Black Diamond Rd., Ravensdale, WA 98051, West side of haul road

Coordinates (Lat, Lon WGS84)
 47.343, -121.993 (est)

Exploration Number

ATP-4

Contractor

N/A

Equipment

Excavator

Sampling Method

Grab

Ground Surface (GS) Elev.

NA

Operator

Dean

Exploration Method(s)

Test Pit

Work Start/Completion Dates

4/5/2018

Top of Casing Elev.

NA

Depth to Water (Below GS)

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Completion and Notes	Sample Type/ID	Analytical Sample Number & Lab Test(s)	Field Tests	Material Type	Description	Depth (ft)
1		Backfilled with spoils					<p>FILL</p> <p>Moist, gray, gravelly, silty SAND (SM); fine to medium sand, fine gravel.</p>	1
2				ATP-4-Slag High pH Leachable Pb, As			Slag fragments between 1 and 3 feet bgs.	2
3							<p>Bottom of exploration at 3 ft. bgs.</p> <p>Note: Test pit terminated at refusal.</p>	3
4								4

Legend

Grab sample

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: KB
 Approved by:

Exploration Log
ATP-4

Sheet 1 of 1