

## **Appendix F**

### **Borehole Geophysical Logging Results**

**BOREHOLE GEOPHYSICAL LOGGING – DATA REPORT  
BOREHOLES 114-MW4D DEEPENED, 114-MW61D DEEPENED,  
114-MW66D DEEPENED, 114-MW71D, & 114-MW72D  
PPG SITE 114 – GARFIELD AVENUE GROUP SITES  
JERSEY CITY, NEW JERSEY**

*Prepared for:*

AECOM  
Two City Center, Suite 200  
Portland, Maine 04101

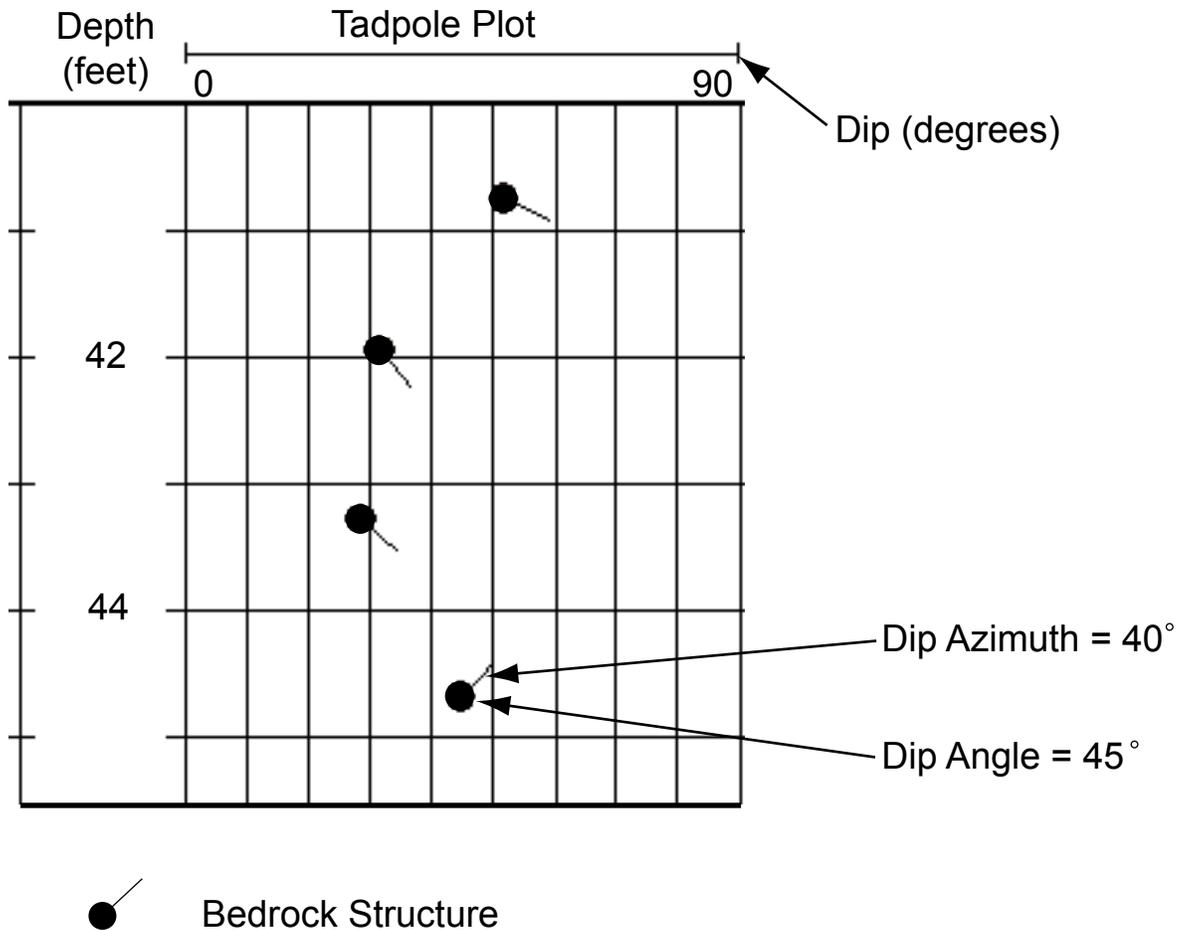
*Prepared by:*

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846 Main Street  
Fords, New Jersey 08863

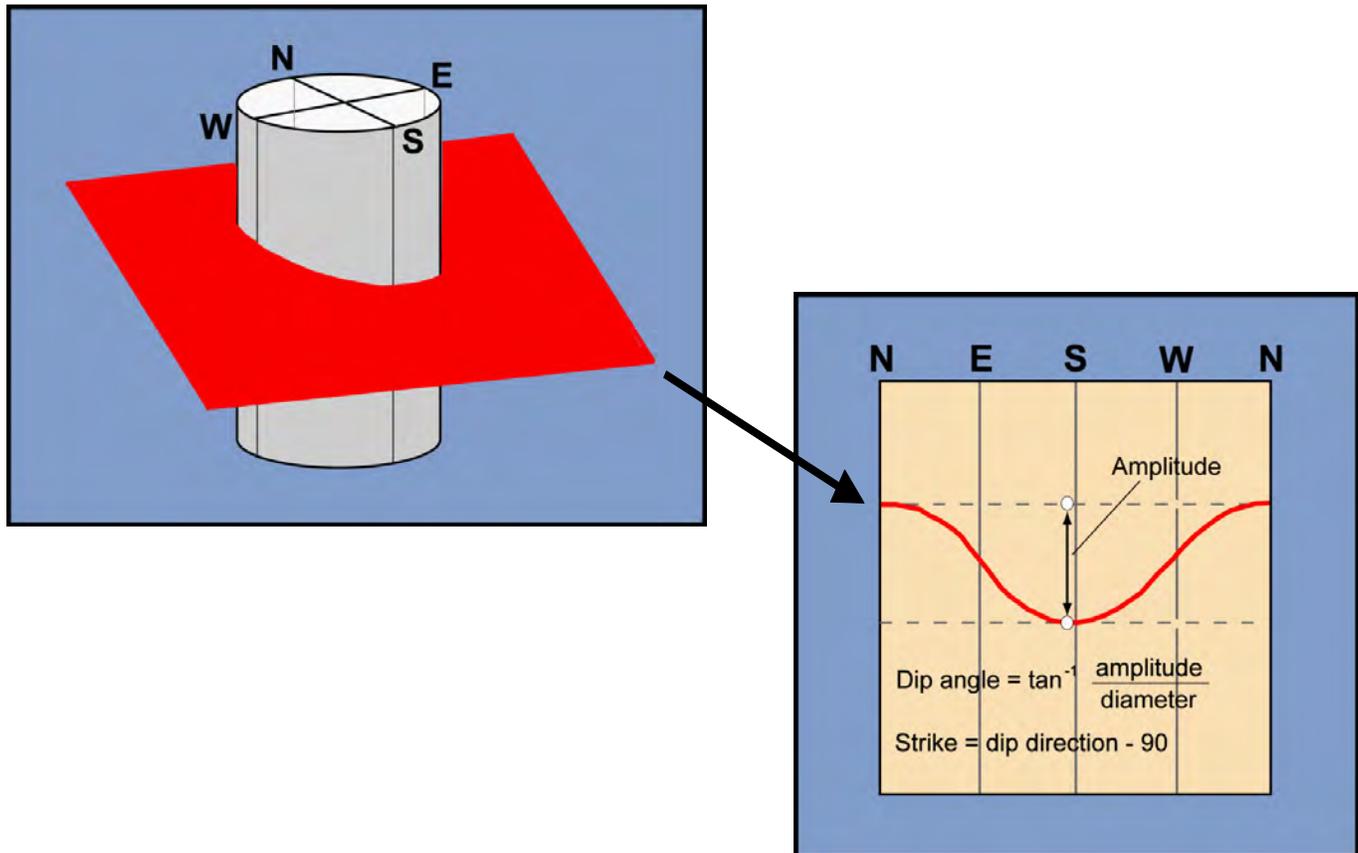
File 19RG66  
February 2022

Tadpole	Structure Category (Symbol Color)	Description
	Bedding (Brown)	Planar geologic feature interpreted as bedding
	Fracture Rank 1 (Light Blue)	Minor Fracture - not distinct and may not be continuous around the borehole
	Fracture Rank 2 (Blue)	Intermediate Fracture - distinct and continuous around the borehole with little or no apparent aperture
	Fracture Rank 3 (Red)	Major Fracture - distinct and continuous around the borehole with apparent aperture

**Figure 1.** Key to bedrock structure categories.



**Figure 2.** Tadpole plot explanation. The orientation of the bedrock structures is graphically displayed by a tadpole consisting of a circle, the head, and a line, the tail. The position of the head, left to right on the tadpole plot, gives the dip angle of the structure. The left side of the track indicates a dip angle of  $0^\circ$ , and the right side of the track indicates a dip angle of  $90^\circ$  from horizontal. The orientation of the tail gives the dip azimuth of the structure and can be read like a compass. The tail pointing directly up is  $0^\circ$ , north.



**Figure 3.** Televiewer explanation. The image on the left depicts a planar structure in red, such as a fracture or bedding plane, intersected by a borehole. The image on the right depicts the same structure unwrapped as it would be displayed in an optical televiewer (OTV) or acoustic televiewer (ATV) log.

Figure modified from: Garfield, R.L., Day-Lewis, F.D., Gray, M.B., Johnson, C.D., Williams, J.H. and Day-Lewis, A.D.F., 2003, Fractured-Rock Aquifer Characterization within a Regional Geologic Context: Results from the Bucknell University Hydrogeophysics Test Site, GSA Northeastern Section, 38th Annual Meeting, Paper No. 25-19.

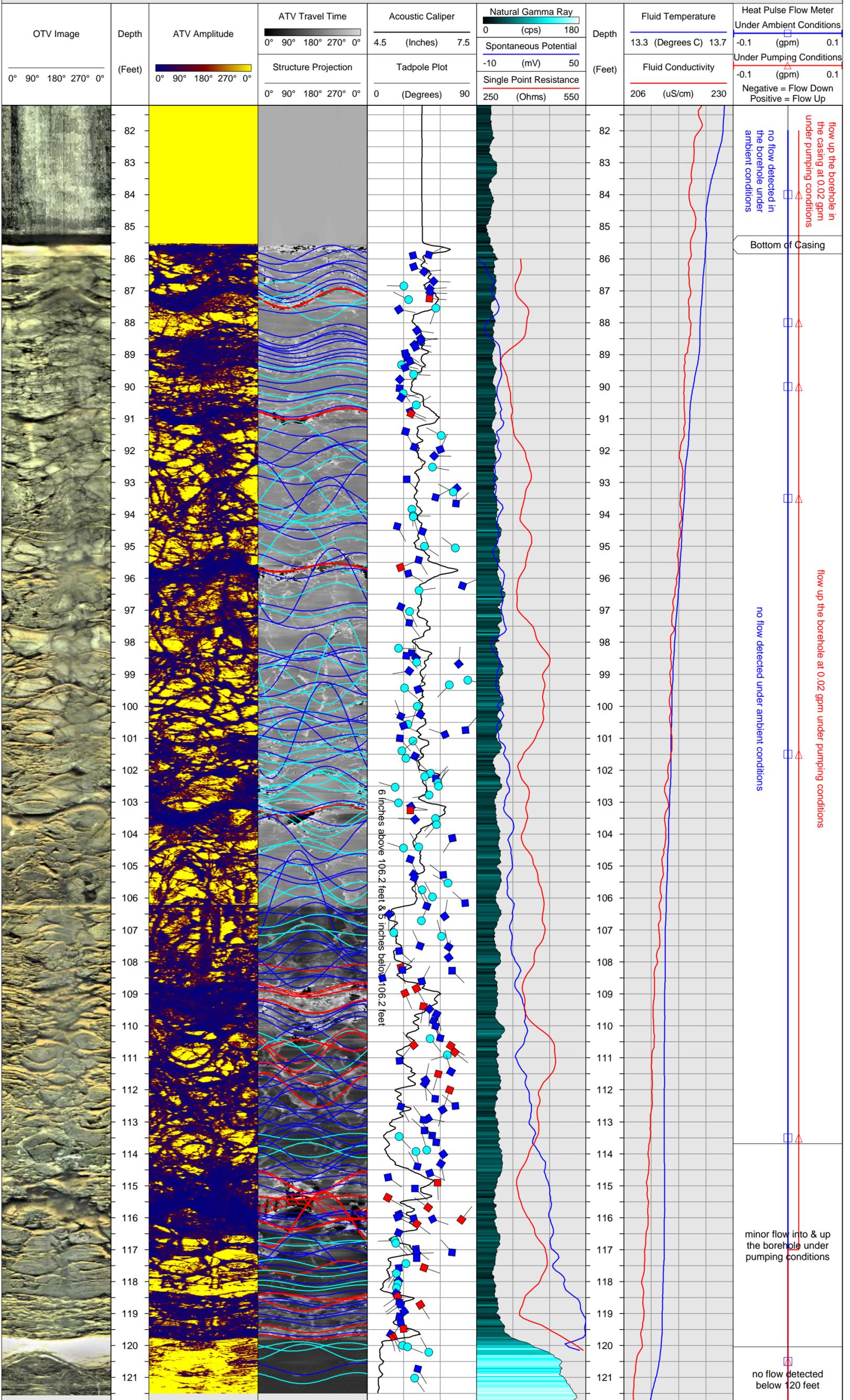
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Mikko Aarnio  
PROJECT REP(S) ON-SITE: Tina Miller  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing  
TOP OF CASING: 0.1 Feet Below the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 12.8° West)  
BOREHOLE DIAMETER: 6 Inches to 106.2 Feet; 5 Inches 106.2 - 121.9 Feet  
WATER LEVEL DEPTH: 40.6 Feet

### STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3

### 114-MW4D - Borehole Geophysical Logs



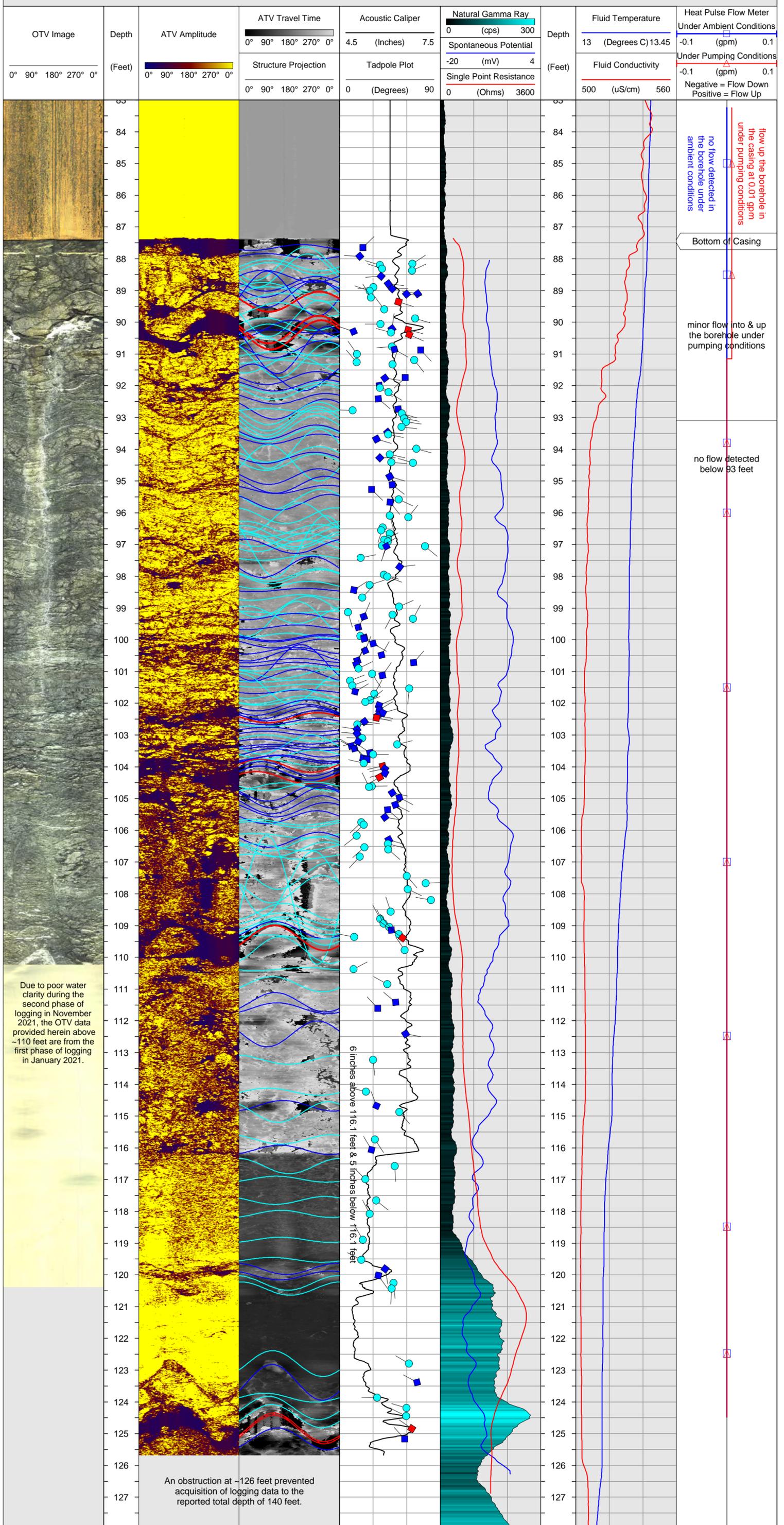
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Mikko Aarnio  
PROJECT REP(S) ON-SITE: Tina Miller  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing (on January 15, 2021)  
TOP OF CASING: 2.3 Feet Above the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 12.8° West)  
BOREHOLE DIAMETER: 6 Inches to 116.1 Feet; 5 Inches 116.1 - 128.0 Feet  
WATER LEVEL DEPTH: 13.2 Feet

**STRUCTURE LEGEND**

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3

114-MW61D - Borehole Geophysical Logs



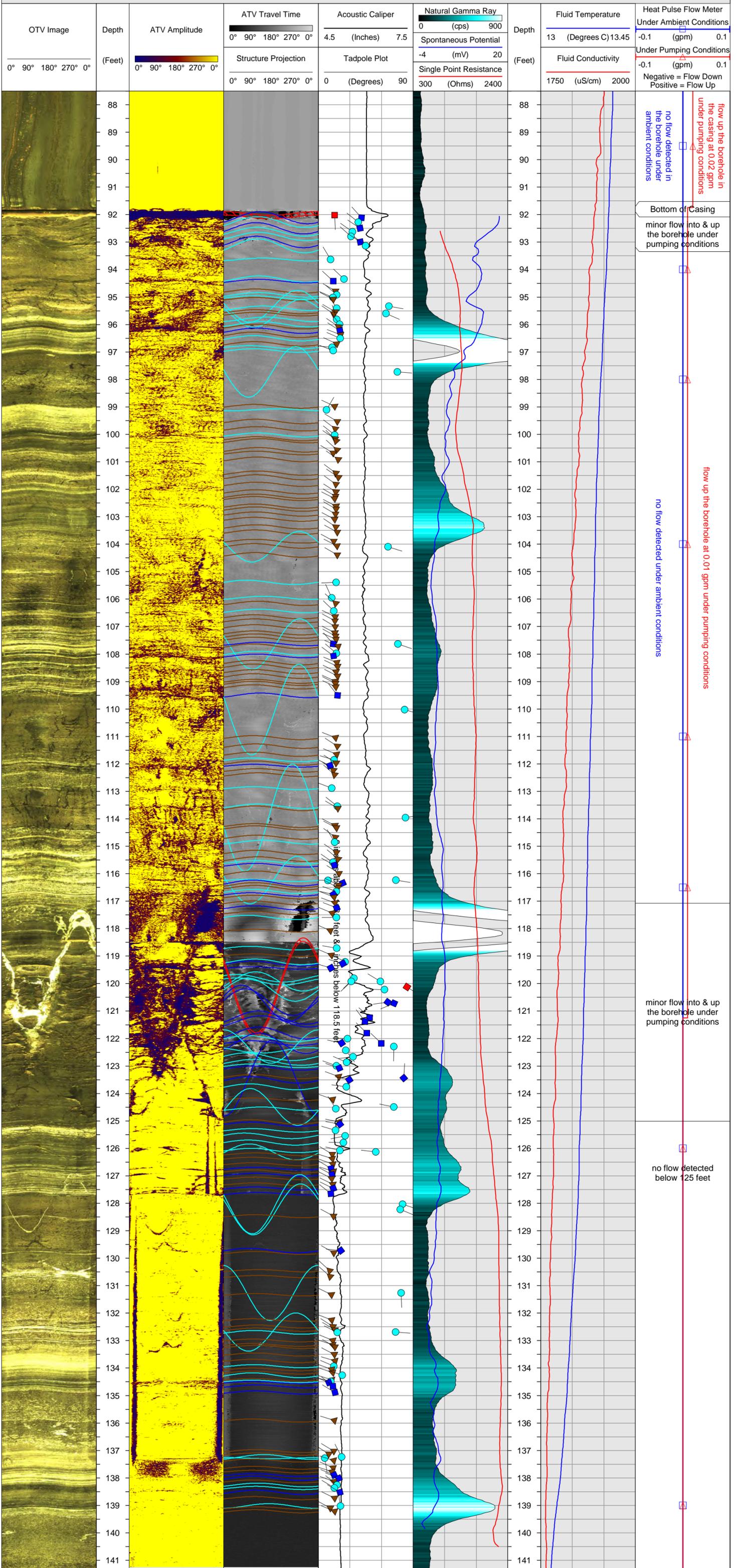
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PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Mikko Aarnio  
PROJECT REP(S) ON-SITE: Tina Miller  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing  
TOP OF CASING: 2.2 Feet Above the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 12.8° West)  
BOREHOLE DIAMETER: 6 Inches to 118.5 Feet; 5 Inches 118.5 - 141.4 Feet  
WATER LEVEL DEPTH: 8.5 Feet

STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3
- ▲ Bedding

114-MW66D - Borehole Geophysical Logs



# HAGER-RICHTER GEOSCIENCE, INC.

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## 114-MW71D - BOREHOLE GEOPHYSICAL LOGS

DATE(S) LOGGED: November 19, 2021

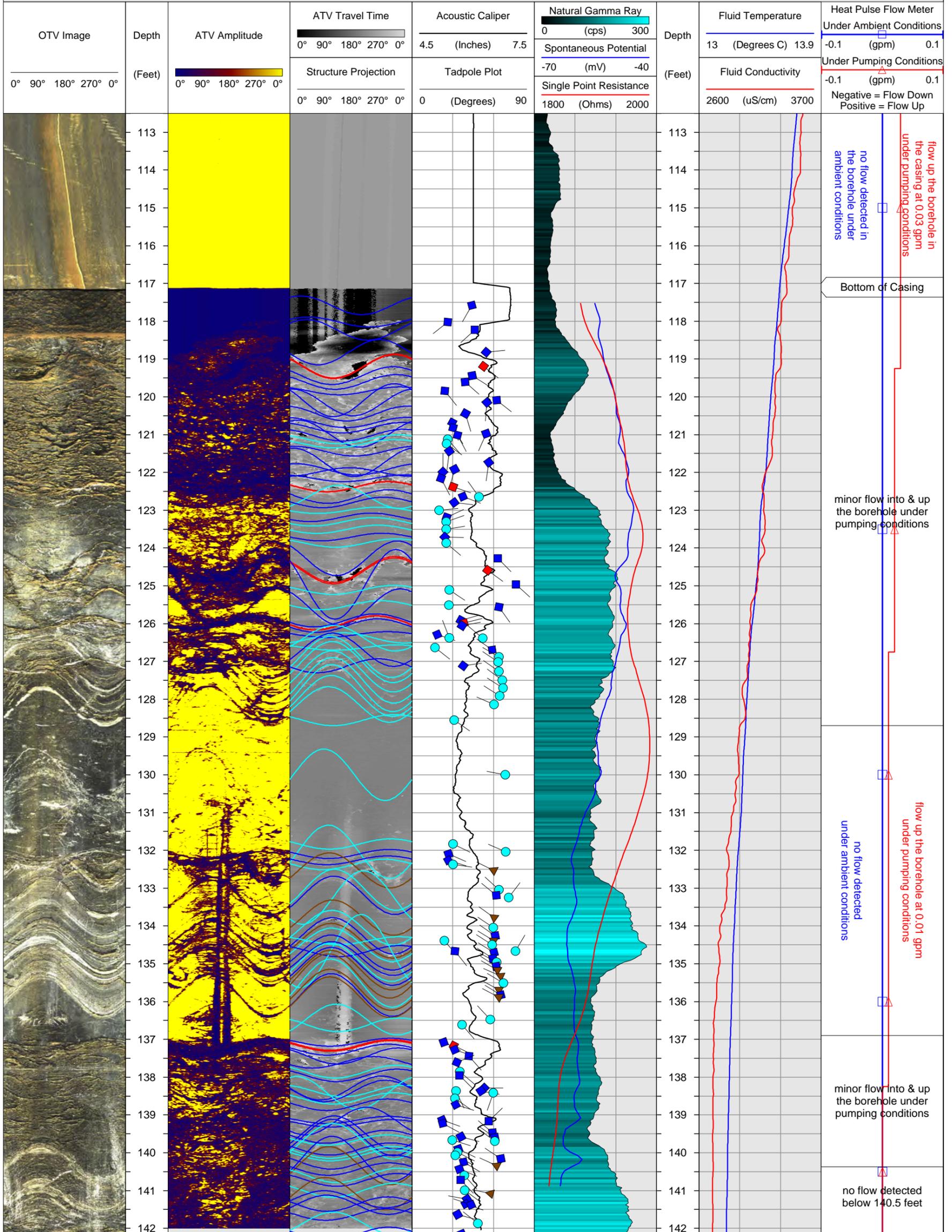
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PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Mikko Aarnio  
PROJECT REP(S) ON-SITE: Tina Miller  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing  
TOP OF CASING: 1.7 Feet Above the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 12.8° West)  
BOREHOLE DIAMETER: 6 Inches  
WATER LEVEL DEPTH: 50.5 Feet

### STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3
- ▲ Bedding

### 114-MW71D - Borehole Geophysical Logs



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## 114-MW72D - BOREHOLE GEOPHYSICAL LOGS

DATE(S) LOGGED: November 19 & 22, 2021

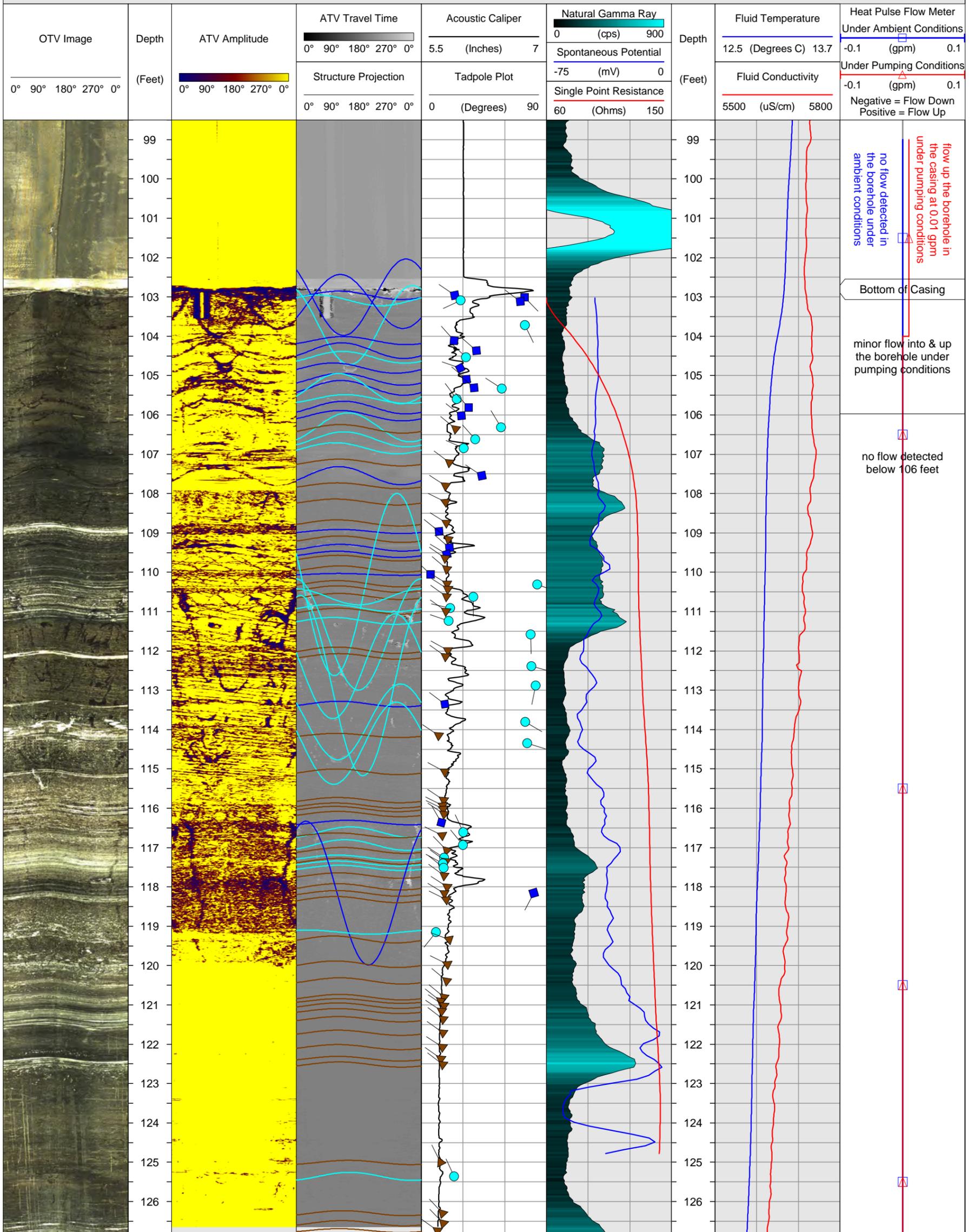
CLIENT: AECOM  
 PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
 LOCATION: Jersey City, New Jersey  
 LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Mikko Aarnio  
 PROJECT REP(S) ON-SITE: Tina Miller  
 LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
 LOG DATUM: Top of the 6-Inch Steel Casing  
 TOP OF CASING: 2.1 Feet Above the Ground Surface  
 ORIENTATION REFERENCE: True North (Magnetic Declination = 12.8° West)  
 BOREHOLE DIAMETER: 6 Inches  
 WATER LEVEL DEPTH: 6.2 Feet

### STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ▲ Bedding

### 114-MW72D - Borehole Geophysical Logs



HAGER-RICHTER GEOSCIENCE, INC.	
114-MW4D Deepened - Summary of Borehole Flow Under Pumping Conditions	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 22, 2021
LOG DATUM	Top of the 6-Inch Steel Casing

114-MW4D Deepened - Summary of Borehole Flow Under Pumping Conditions	
Depth (Feet)	Comments
40.6	Water Level
49.0 - 50.0	Location of Pump for HPFM Under Pumping Conditions
50.0 - 85.6	flow up the borehole in the casing at 0.02 gpm under pumping conditions
85.6	Bottom of the 6-Inch Steel Casing
85.6 - 113.7	flow up the borehole at 0.02 gpm under pumping conditions
113.7 - 120.0	minor flow into & up the borehole under pumping conditions
120.0 - 121.9	no flow detected under pumping conditions
121.9	Bottom of the Borehole (based on the geophysical logging)

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW61D Deepened- Summary of Borehole Flow Under Pumping Conditions	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Steel Casing (on January 15, 2021)

**114-MW61D Deepened- Summary of Borehole Flow Under Pumping Conditions**

Depth (Feet)	Comments
13.2	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 87.4	flow up the borehole in the casing at 0.01 gpm under pumping conditions
87.4	Bottom of the 6-Inch Steel Casing
87.4 - 93.1	minor flow into & up the borehole under pumping conditions
93.1 - 128.0	no flow detected under pumping conditions
128.0	Bottom of the Borehole (based on the geophysical logging)

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW66D Deepened - Summary of Borehole Flow Under Pumping Conditions	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Steel Casing

**114-MW66D Deepened - Summary of Borehole Flow Under Pumping Conditions**

Depth (Feet)	Comments
8.5	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 91.8	flow up the borehole in the casing at 0.02 gpm under pumping conditions
91.8	Bottom of the 6-Inch Steel Casing
91.8 - 93.1	minor flow into & up the borehole under pumping conditions
93.1 - 117.1	flow up the borehole at 0.01 gpm under pumping conditions
117.1 - 125.0	minor flow into & up the borehole under pumping conditions
125.0 - 141.4	no flow detected under pumping conditions
141.4	Bottom of the Borehole (based on the geophysical logging)

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW71D - Summary of Borehole Flow Under Pumping Conditions	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Steel Casing

**114-MW71D - Summary of Borehole Flow Under Pumping Conditions**

Depth (Feet)	Comments
50.5	Water Level
57.0 - 58.0	Location of Pump for HPFM Under Pumping Conditions
58.0 - 117.1	flow up the borehole in the casing at 0.03 gpm under pumping conditions
117.1	Bottom of the 6-Inch Steel Casing
117.1 - 128.7	minor flow into & up the borehole under pumping conditions
128.7 - 136.9	flow up the borehole at 0.01 gpm under pumping conditions
136.9 - 140.4	minor flow into & up the borehole under pumping conditions
140.4 - 142.2	no flow detected under pumping conditions
142.2	Bottom of the Borehole (based on the geophysical logging)

<b>HAGER-RICHTER GEOSCIENCE, INC.</b>	
<b>114-MW72D - Summary of Borehole Flow Under Pumping Conditions</b>	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19 & 22, 2021
LOG DATUM	Top of the 6-Inch Steel Casing

**114-MW72D - Summary of Borehole Flow Under Pumping Conditions**

<b>Depth (Feet)</b>	<b>Comments</b>
6.2	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 102.8	flow up the borehole in the casing at 0.01 gpm under pumping conditions
102.8	Bottom of the 6-Inch Steel Casing
102.8 - 106.0	minor flow into & up the borehole under pumping conditions
106.0 - 127.2	no flow detected under pumping conditions
127.2	Bottom of the Borehole (based on the geophysical logging)

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## 114-MW4D DEEPENED - BEDROCK FRACTURE STATISTICS PLOTS

DATE(S) LOGGED: November 22, 2021

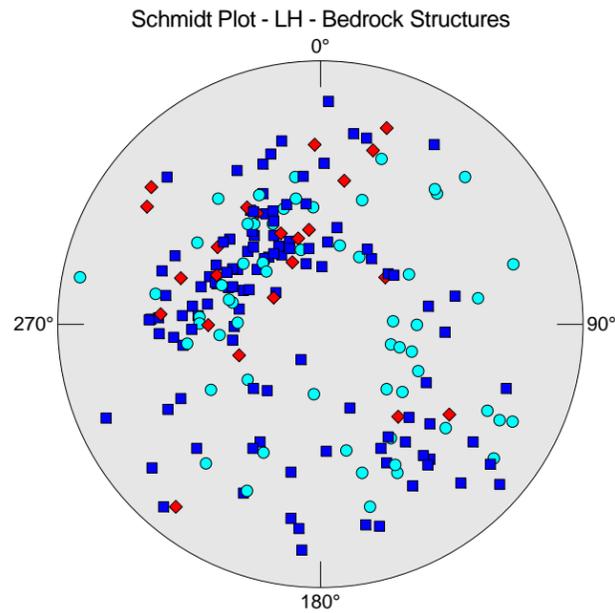
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 12.8° West

### STRUCTURE LEGEND

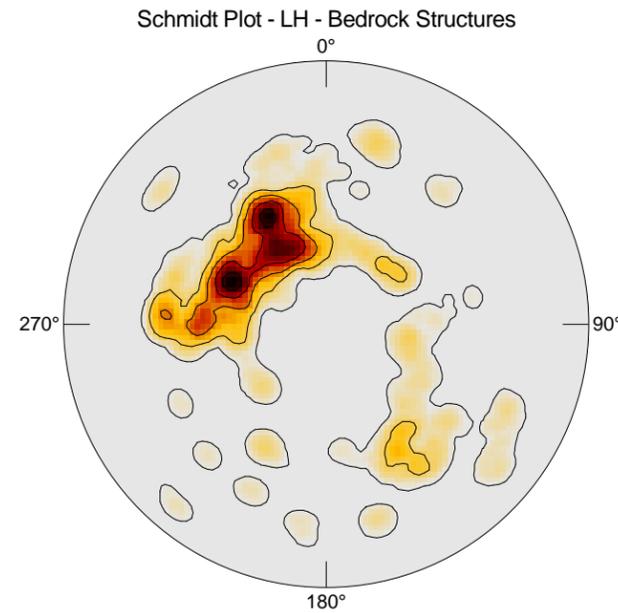
● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3

Stereogram - Lower Hemisphere  
of Bedrock Fractures



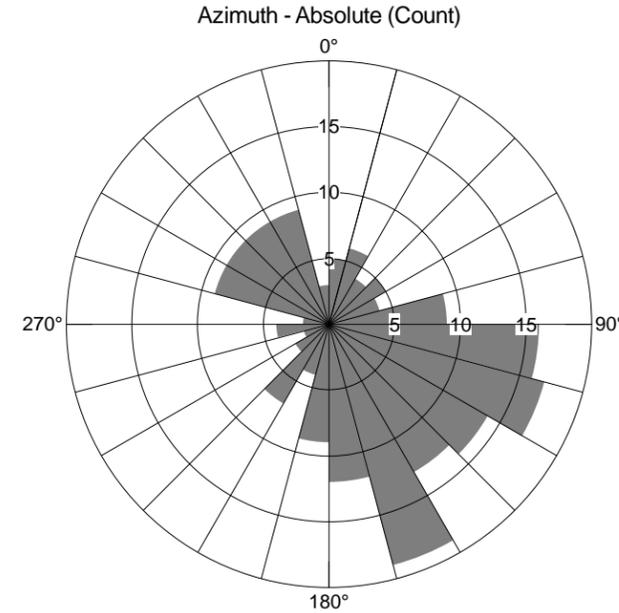
	Counts	Dip[deg]	Azi[deg]
Mean	194	43.22	127.61
■	112	43.55	116.56
●	59	42.37	183.58
◆	23	43.82	143.26

Contoured Stereogram - Lower Hemisphere  
of Bedrock Fractures



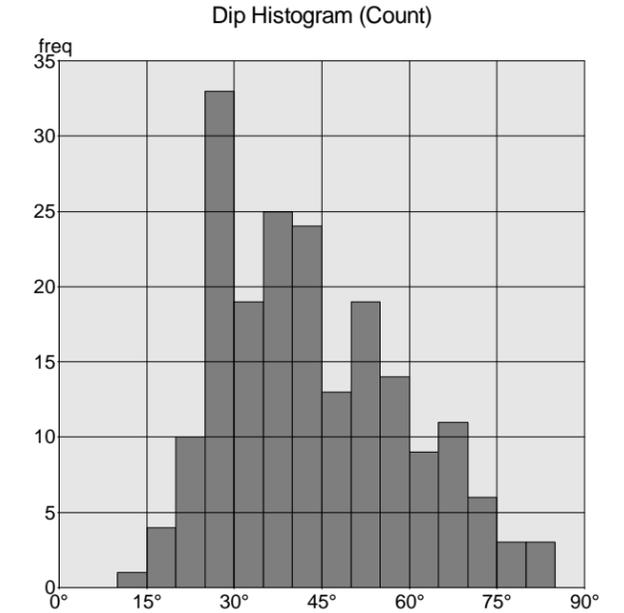
	Counts	Dip[deg]	Azi[deg]
Mean	194	43.22	127.61
■	112	43.55	116.56
●	59	42.37	183.58
◆	23	43.82	143.26

Dip Azimuth Rose Diagram  
of Bedrock Fractures



Components:	Azimuth
Counts:	194.00
Mean (2D):	127.61
Std.Dev.:	93.59
Min:	4.79
Max:	357.38

Dip Angle Histogram  
of Bedrock Fractures



Counts:	194.00
Mean (2D):	43.22
Std.Dev.:	15.54
Min:	12.56
Max:	82.76

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## 114-MW61D DEEPENED - BEDROCK FRACTURE STATISTICS PLOTS

DATE(S) LOGGED: November 19, 2021

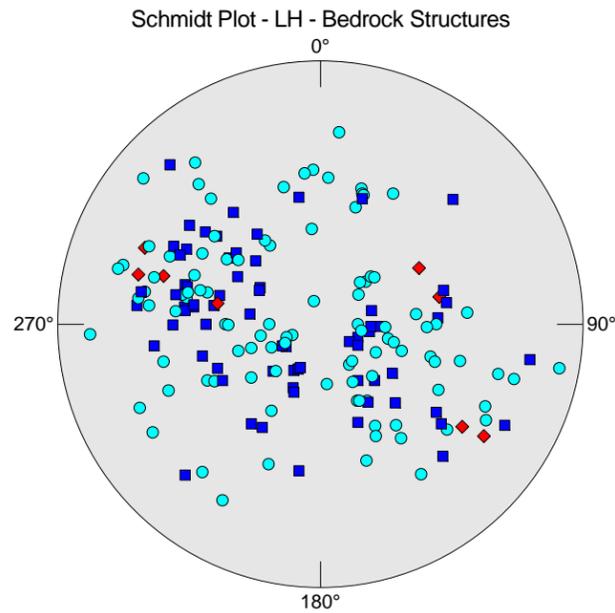
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 12.8° West

### STRUCTURE LEGEND

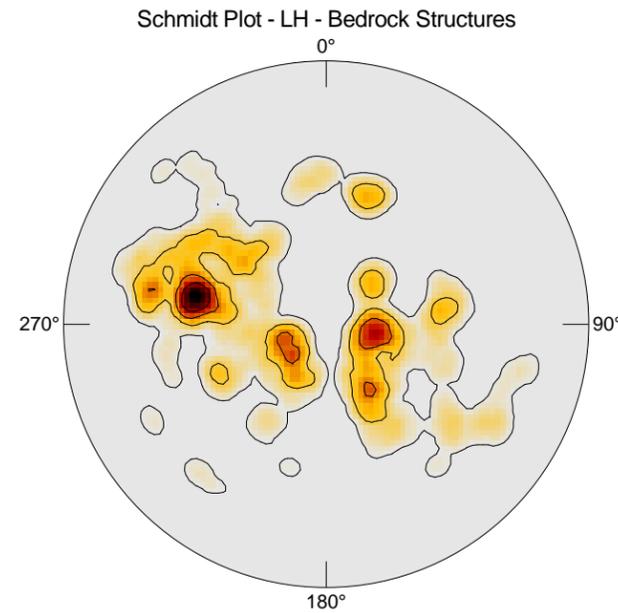
● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3

Stereogram - Lower Hemisphere  
of Bedrock Fractures



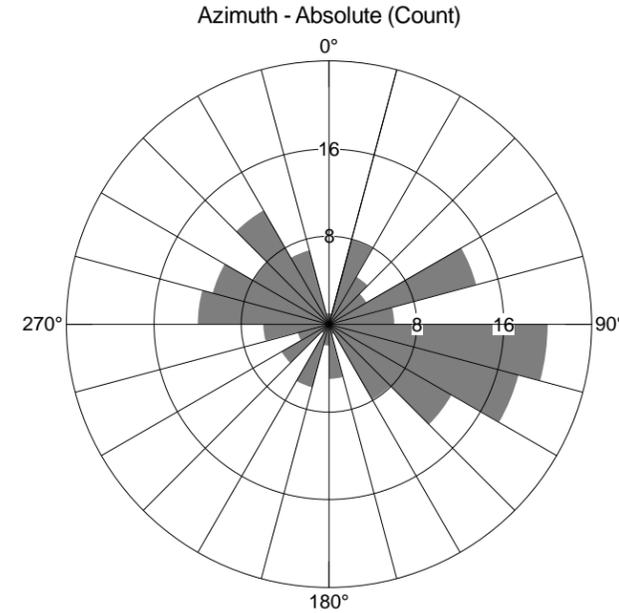
	Counts	Dip[deg]	Azi[deg]
Mean	177	38.84	78.49
■	69	36.56	73.55
●	100	39.47	83.37
◆	8	50.50	155.23

Contoured Stereogram - Lower Hemisphere  
of Bedrock Fractures



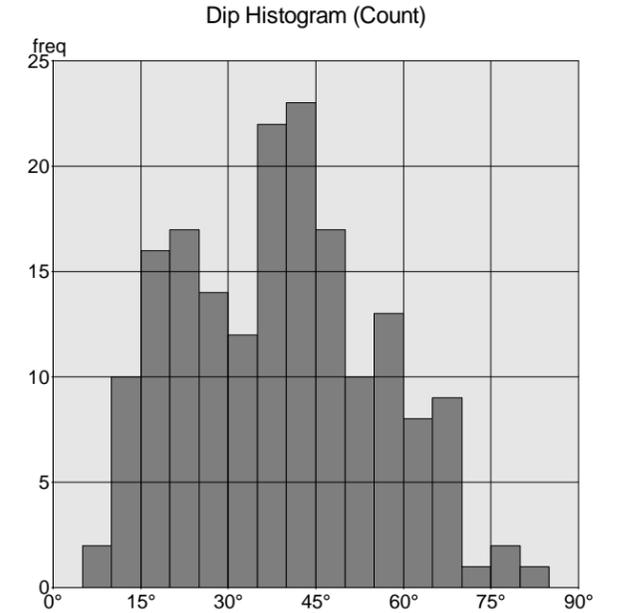
	Counts	Dip[deg]	Azi[deg]
Mean	177	38.84	78.49
■	69	36.56	73.55
●	100	39.47	83.37
◆	8	50.50	155.23

Dip Azimuth Rose Diagram  
of Bedrock Fractures



Components:	Azimuth
Counts:	177.00
Mean (2D):	78.49
Std.Dev.:	110.44
Min:	8.43
Max:	353.78

Dip Angle Histogram  
of Bedrock Fractures



Counts:	177.00
Mean (2D):	38.84
Std.Dev.:	16.77
Min:	7.53
Max:	81.75

# HAGER-RICHTER GEOSCIENCE, INC.

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Tel: 732.661.0555

## 114-MW66D DEEPENED - BEDROCK STRUCTURE STATISTICS PLOTS

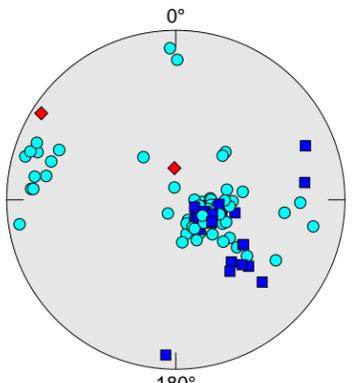
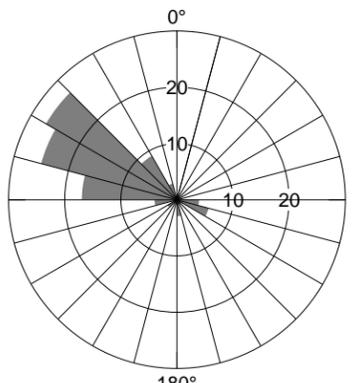
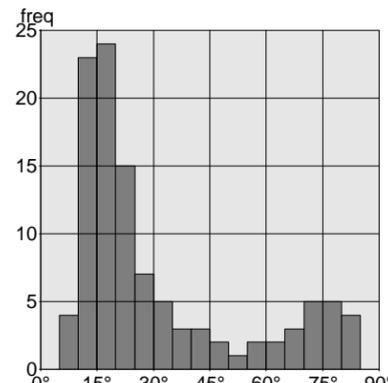
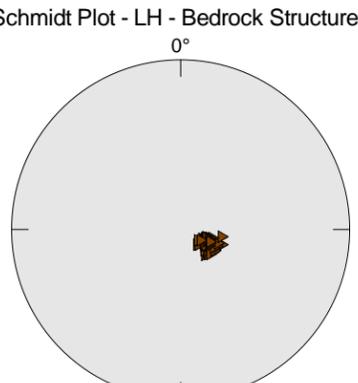
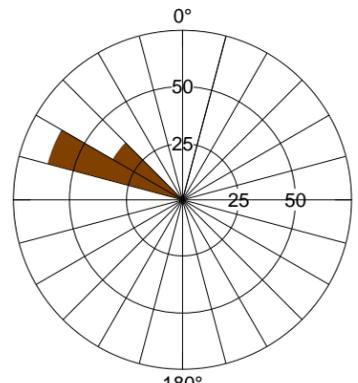
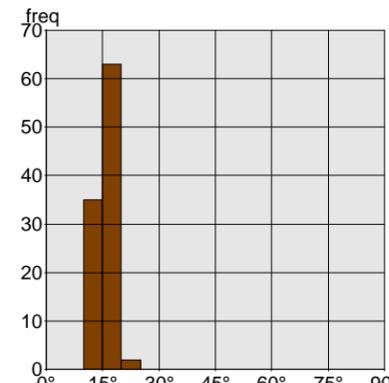
DATE(S) LOGGED: November 19, 2021

CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 12.8° West

### STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding

Stereogram - Lower Hemisphere of Fractures	Dip Azimuth Rose Diagram of Fractures	Dip Angle Histogram of Fractures	Stereogram - Lower Hemisphere of Bedding	Dip Azimuth Rose Diagram of Bedding	Dip Angle Histogram of Bedding																																																																												
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# HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire  
Tel: 603.893.9944  
Fords, New Jersey  
Tel: 732.661.0555

## 114-MW71D - BEDROCK STRUCTURE STATISTICS PLOTS

DATE(S) LOGGED: November 19, 2021

CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

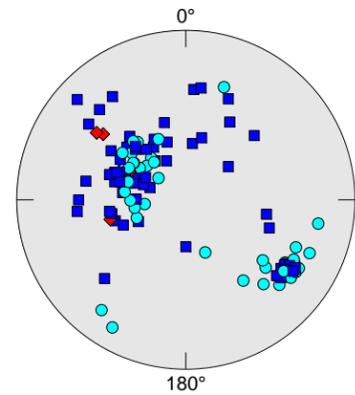
HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 12.8° West

### STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding

Stereogram - Lower Hemisphere  
of Fractures

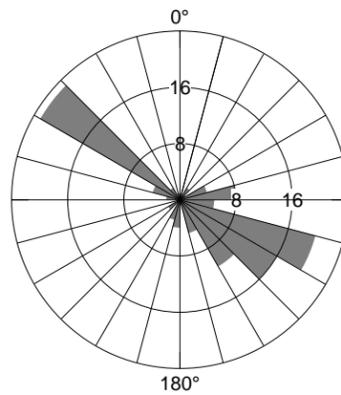
Schmidt Plot - LH - Bedrock Structures



	Counts	Dip[deg]	Azi[deg]
Mean	114	43.08	118.47
■	64	41.59	126.40
◆	5	41.54	111.67
●	45	45.40	52.23

Dip Azimuth Rose Diagram  
of Fractures

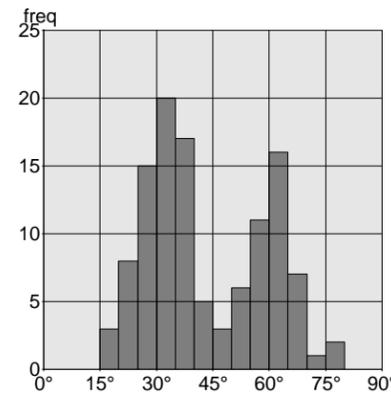
Azimuth - Absolute (Count)



Components:	Azimuth
Counts:	114.00
Mean (2D):	118.47
Std.Dev.:	90.20
Min:	30.13
Max:	359.78

Dip Angle Histogram  
of Fractures

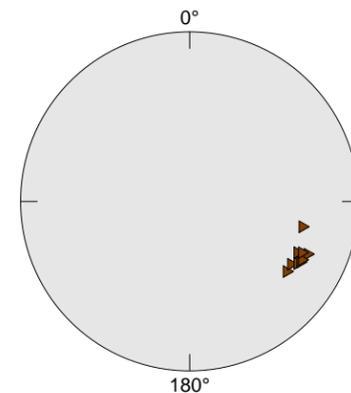
Dip Histogram (Count)



Counts:	114.00
Mean (2D):	43.08
Std.Dev.:	15.85
Min:	16.97
Max:	76.54

Stereogram - Lower Hemisphere  
of Bedding

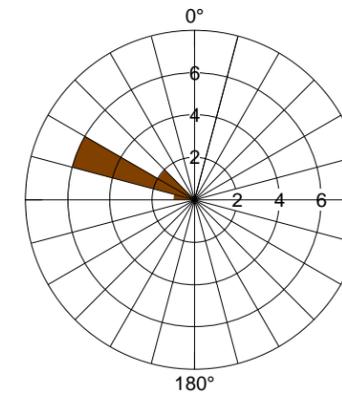
Schmidt Plot - LH - Bedrock Structures



	Counts	Dip[deg]	Azi[deg]
Mean	9	61.92	296.74
▼	9	61.92	296.74

Dip Azimuth Rose Diagram  
of Bedding

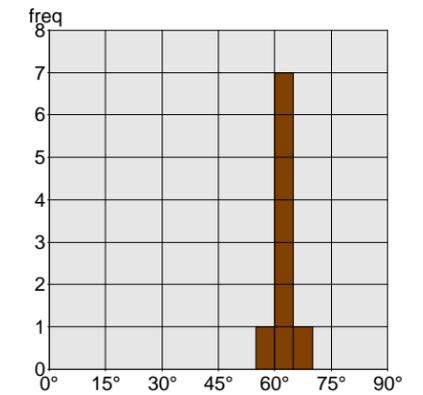
Azimuth - Absolute (Count)



Components:	Azimuth
Counts:	9.00
Mean (2D):	296.74
Std.Dev.:	6.12
Min:	282.57
Max:	305.93

Dip Angle Histogram  
of Bedding

Dip Histogram (Count)



Counts:	9.00
Mean (2D):	61.92
Std.Dev.:	2.30
Min:	57.93
Max:	65.48

# HAGER-RICHTER GEOSCIENCE, INC.

Salem, New Hampshire  
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Fords, New Jersey  
Tel: 732.661.0555

## 114-MW72D - BEDROCK STRUCTURE STATISTICS PLOTS

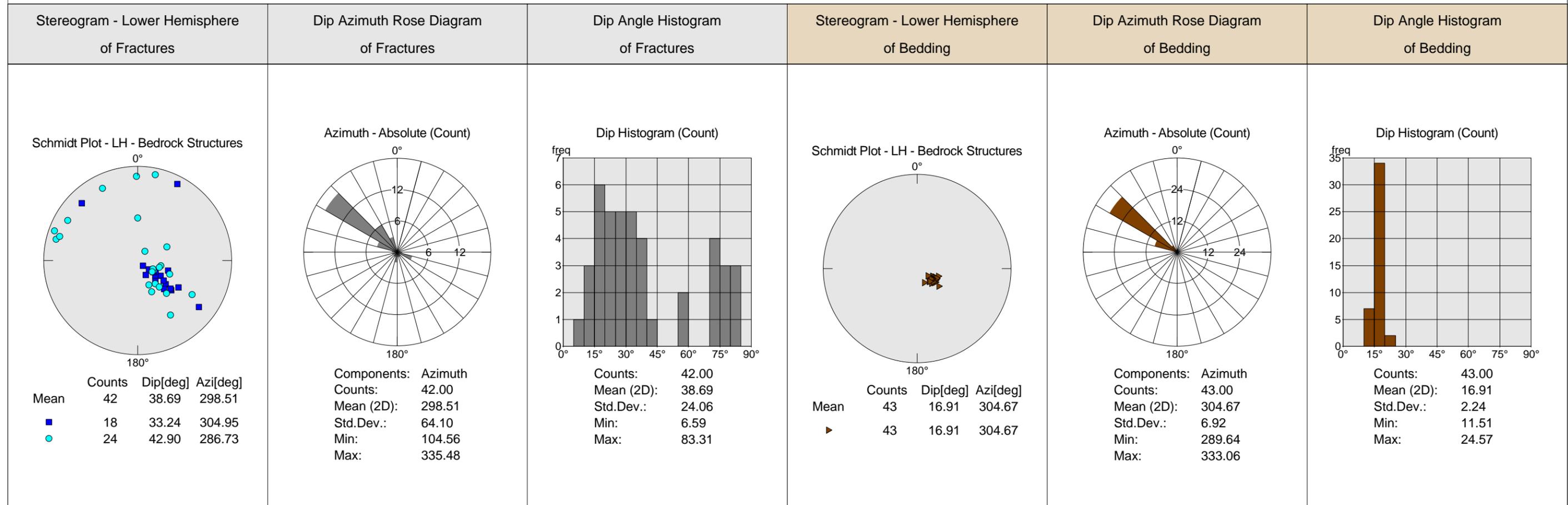
DATE(S) LOGGED: November 19 & 22, 2021

CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 12.8° West

### STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding



HAGER-RICHTER GEOSCIENCE, INC.	
114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 22, 2021
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 12.8° West)
DIP ANGLE	Measured from Horizontal

**114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
85.9	62	50	Fracture Rank 2
85.9	120	38	Fracture Rank 2
86.3	114	38	Fracture Rank 2
86.4	85	47	Fracture Rank 2
86.7	92	54	Fracture Rank 2
86.9	270	31	Fracture Rank 1
86.9	87	51	Fracture Rank 2
87.1	93	52	Fracture Rank 2
87.3	94	51	Fracture Rank 3
87.3	295	34	Fracture Rank 1
87.6	200	57	Fracture Rank 1
87.6	102	26	Fracture Rank 2
88.3	99	41	Fracture Rank 2
88.5	94	44	Fracture Rank 2
88.6	82	44	Fracture Rank 2
88.7	95	39	Fracture Rank 2
88.8	108	40	Fracture Rank 2
89.0	124	32	Fracture Rank 2
89.1	123	33	Fracture Rank 2
89.2	112	36	Fracture Rank 2
89.3	104	28	Fracture Rank 1
89.4	112	32	Fracture Rank 2
89.6	94	39	Fracture Rank 1
89.8	89	27	Fracture Rank 2
90.1	142	27	Fracture Rank 2
90.2	106	30	Fracture Rank 1
90.3	80	28	Fracture Rank 2
90.6	60	40	Fracture Rank 1
90.8	113	36	Fracture Rank 2
90.9	116	36	Fracture Rank 3
91.4	152	32	Fracture Rank 2
91.5	297	61	Fracture Rank 1
91.9	153	39	Fracture Rank 2
92.0	25	60	Fracture Rank 2
92.2	92	55	Fracture Rank 2

114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
92.5	100	54	Fracture Rank 1
92.9	135	33	Fracture Rank 2
93.2	182	74	Fracture Rank 2
93.3	297	71	Fracture Rank 1
93.5	61	57	Fracture Rank 2
93.7	50	73	Fracture Rank 2
93.8	175	37	Fracture Rank 1
94.0	91	38	Fracture Rank 1
94.1	162	38	Fracture Rank 1
94.4	149	25	Fracture Rank 2
94.5	156	46	Fracture Rank 2
95.0	123	48	Fracture Rank 1
95.1	308	72	Fracture Rank 1
95.4	148	43	Fracture Rank 2
95.7	70	28	Fracture Rank 3
95.8	119	34	Fracture Rank 2
96.2	66	79	Fracture Rank 2
96.4	82	43	Fracture Rank 1
96.9	158	28	Fracture Rank 2
97.0	154	35	Fracture Rank 1
97.4	142	35	Fracture Rank 2
98.2	92	26	Fracture Rank 1
98.3	143	37	Fracture Rank 2
98.4	138	33	Fracture Rank 2
98.5	359	40	Fracture Rank 2
98.6	349	41	Fracture Rank 1
98.7	5	75	Fracture Rank 2
98.9	260	34	Fracture Rank 2
99.2	101	83	Fracture Rank 1
99.3	224	67	Fracture Rank 1
99.4	127	31	Fracture Rank 1
99.5	28	42	Fracture Rank 2
100.0	198	41	Fracture Rank 1
100.3	258	43	Fracture Rank 2
100.3	342	28	Fracture Rank 2
100.6	311	33	Fracture Rank 1
100.6	113	30	Fracture Rank 2
100.8	41	81	Fracture Rank 2
100.9	289	64	Fracture Rank 2
101.0	139	27	Fracture Rank 2
101.1	145	38	Fracture Rank 1
101.4	53	29	Fracture Rank 1
101.6	163	39	Fracture Rank 2
101.6	84	33	Fracture Rank 1
102.1	310	52	Fracture Rank 1

114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
102.2	170	47	Fracture Rank 1
102.3	45	57	Fracture Rank 2
102.4	39	58	Fracture Rank 1
102.5	24	59	Fracture Rank 1
102.5	287	22	Fracture Rank 1
102.8	261	51	Fracture Rank 1
103.0	287	25	Fracture Rank 1
103.1	100	36	Fracture Rank 2
103.3	89	36	Fracture Rank 3
103.5	222	56	Fracture Rank 1
103.5	274	39	Fracture Rank 2
103.7	220	57	Fracture Rank 1
104.1	212	69	Fracture Rank 2
104.4	328	43	Fracture Rank 1
104.4	287	31	Fracture Rank 1
104.8	155	36	Fracture Rank 2
105.3	173	38	Fracture Rank 2
105.3	308	63	Fracture Rank 2
105.4	157	39	Fracture Rank 2
105.5	298	67	Fracture Rank 1
105.8	155	45	Fracture Rank 1
106.0	333	54	Fracture Rank 1
106.2	312	81	Fracture Rank 2
106.3	334	49	Fracture Rank 2
106.5	182	18	Fracture Rank 2
106.6	9	64	Fracture Rank 2
106.7	24	45	Fracture Rank 1
107.1	6	22	Fracture Rank 1
107.2	345	61	Fracture Rank 1
107.5	334	44	Fracture Rank 2
107.5	347	67	Fracture Rank 2
107.7	131	26	Fracture Rank 2
107.9	6	67	Fracture Rank 2
108.2	165	28	Fracture Rank 3
108.3	46	29	Fracture Rank 2
108.3	134	70	Fracture Rank 2
108.5	29	13	Fracture Rank 2
108.6	29	45	Fracture Rank 2
108.8	150	40	Fracture Rank 3
109.0	156	31	Fracture Rank 3
109.4	190	46	Fracture Rank 3
109.5	181	51	Fracture Rank 2
109.6	164	57	Fracture Rank 2
109.9	160	55	Fracture Rank 2
110.0	151	56	Fracture Rank 2

114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
110.4	330	60	Fracture Rank 2
110.4	141	52	Fracture Rank 1
110.6	320	38	Fracture Rank 3
110.6	124	69	Fracture Rank 3
110.8	129	72	Fracture Rank 3
110.9	253	66	Fracture Rank 1
111.1	39	27	Fracture Rank 2
111.4	344	69	Fracture Rank 2
111.5	197	59	Fracture Rank 3
111.7	12	48	Fracture Rank 2
111.8	173	47	Fracture Rank 2
112.0	199	68	Fracture Rank 3
112.3	321	56	Fracture Rank 2
112.5	309	73	Fracture Rank 2
112.5	152	28	Fracture Rank 2
112.6	194	62	Fracture Rank 2
112.9	101	50	Fracture Rank 2
112.9	324	46	Fracture Rank 2
113.3	312	47	Fracture Rank 2
113.4	322	53	Fracture Rank 2
113.5	137	26	Fracture Rank 1
113.6	323	57	Fracture Rank 2
113.9	344	49	Fracture Rank 1
113.9	169	40	Fracture Rank 1
114.0	190	63	Fracture Rank 2
114.3	168	61	Fracture Rank 2
114.4	329	41	Fracture Rank 2
114.6	115	51	Fracture Rank 2
114.7	126	17	Fracture Rank 2
114.9	178	58	Fracture Rank 3
115.1	133	39	Fracture Rank 2
115.4	120	17	Fracture Rank 3
115.7	305	50	Fracture Rank 3
115.9	114	26	Fracture Rank 2
116.0	116	25	Fracture Rank 2
116.0	299	38	Fracture Rank 2
116.0	109	54	Fracture Rank 2
116.1	38	78	Fracture Rank 3
116.2	127	41	Fracture Rank 3
116.5	157	26	Fracture Rank 2
116.7	268	23	Fracture Rank 1
116.8	134	24	Fracture Rank 1
117.0	130	40	Fracture Rank 2
117.1	318	70	Fracture Rank 2
117.1	88	41	Fracture Rank 2

114-MW4D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
117.3	316	41	Fracture Rank 2
117.4	241	32	Fracture Rank 1
117.6	108	47	Fracture Rank 3
117.6	218	26	Fracture Rank 2
117.7	210	24	Fracture Rank 1
118.0	185	26	Fracture Rank 2
118.1	194	25	Fracture Rank 1
118.2	165	24	Fracture Rank 1
118.4	171	24	Fracture Rank 2
118.5	234	25	Fracture Rank 3
118.6	233	26	Fracture Rank 2
118.7	236	28	Fracture Rank 2
118.7	148	44	Fracture Rank 3
118.9	190	31	Fracture Rank 2
119.1	147	26	Fracture Rank 2
119.3	212	28	Fracture Rank 2
119.5	173	30	Fracture Rank 3
119.7	166	19	Fracture Rank 2
119.7	155	21	Fracture Rank 3
120.0	314	29	Fracture Rank 1
120.0	112	33	Fracture Rank 1
120.2	332	51	Fracture Rank 1
120.7	149	41	Fracture Rank 2
121.0	144	39	Fracture Rank 1

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Casing (on January 15, 2021)
DIP AZIMUTH	True North (Magnetic Declination = 12.8° West)
DIP ANGLE	Measured from Horizontal

**114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
87.7	45	21	Fracture Rank 2
87.9	273	18	Fracture Rank 2
88.2	57	65	Fracture Rank 1
88.2	286	36	Fracture Rank 1
88.3	288	38	Fracture Rank 1
88.4	65	65	Fracture Rank 1
88.6	266	37	Fracture Rank 2
88.8	98	44	Fracture Rank 2
88.9	263	30	Fracture Rank 1
88.9	90	47	Fracture Rank 2
89.0	288	26	Fracture Rank 1
89.1	280	70	Fracture Rank 2
89.1	96	60	Fracture Rank 2
89.2	329	28	Fracture Rank 1
89.4	107	53	Fracture Rank 3
89.6	323	39	Fracture Rank 1
89.9	107	68	Fracture Rank 1
90.1	269	35	Fracture Rank 1
90.2	9	47	Fracture Rank 2
90.2	105	62	Fracture Rank 3
90.3	289	11	Fracture Rank 2
90.3	285	45	Fracture Rank 1
90.4	114	63	Fracture Rank 3
90.8	265	47	Fracture Rank 1
90.9	119	49	Fracture Rank 2
90.9	137	73	Fracture Rank 2
91.0	325	15	Fracture Rank 1
91.2	142	68	Fracture Rank 1
91.3	321	14	Fracture Rank 1
91.3	21	47	Fracture Rank 1
91.7	226	59	Fracture Rank 2
91.8	99	42	Fracture Rank 2
92.0	126	36	Fracture Rank 2
92.1	125	36	Fracture Rank 1
92.2	121	44	Fracture Rank 1

114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
92.4	130	35	Fracture Rank 2
92.7	127	53	Fracture Rank 2
92.8	267	11	Fracture Rank 1
92.9	106	56	Fracture Rank 1
93.0	101	58	Fracture Rank 1
93.1	99	59	Fracture Rank 1
93.3	97	55	Fracture Rank 1
93.5	97	43	Fracture Rank 2
93.5	102	43	Fracture Rank 1
93.7	106	33	Fracture Rank 2
94.0	105	69	Fracture Rank 1
94.2	102	44	Fracture Rank 1
94.3	90	35	Fracture Rank 2
94.4	95	46	Fracture Rank 1
94.4	286	66	Fracture Rank 1
94.9	106	45	Fracture Rank 2
95.1	128	48	Fracture Rank 2
95.3	134	29	Fracture Rank 2
95.6	114	52	Fracture Rank 1
95.7	142	45	Fracture Rank 2
96.1	164	46	Fracture Rank 1
96.1	39	61	Fracture Rank 1
96.5	197	39	Fracture Rank 1
96.6	107	37	Fracture Rank 1
96.7	197	45	Fracture Rank 1
96.8	197	44	Fracture Rank 1
96.8	64	40	Fracture Rank 1
96.9	198	44	Fracture Rank 1
97.0	63	38	Fracture Rank 1
97.1	130	77	Fracture Rank 1
97.1	198	43	Fracture Rank 2
97.4	80	19	Fracture Rank 1
97.7	83	54	Fracture Rank 2
98.0	107	40	Fracture Rank 1
98.0	112	43	Fracture Rank 1
98.3	73	27	Fracture Rank 1
98.4	56	12	Fracture Rank 2
98.7	45	21	Fracture Rank 1
99.0	66	54	Fracture Rank 1
99.1	160	7	Fracture Rank 1
99.2	209	47	Fracture Rank 1
99.3	23	22	Fracture Rank 2
99.3	29	66	Fracture Rank 1
99.6	29	17	Fracture Rank 2
99.9	354	20	Fracture Rank 1

114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
99.9	119	22	Fracture Rank 2
100.0	117	22	Fracture Rank 2
100.1	118	30	Fracture Rank 2
100.4	21	24	Fracture Rank 2
100.5	29	38	Fracture Rank 2
100.7	26	16	Fracture Rank 2
100.7	42	67	Fracture Rank 2
100.8	26	15	Fracture Rank 2
100.9	63	17	Fracture Rank 1
101.1	146	29	Fracture Rank 1
101.1	35	38	Fracture Rank 2
101.3	68	9	Fracture Rank 1
101.4	66	11	Fracture Rank 1
101.5	186	62	Fracture Rank 1
101.6	59	13	Fracture Rank 2
101.7	29	30	Fracture Rank 1
101.9	53	26	Fracture Rank 1
102.0	70	22	Fracture Rank 1
102.1	67	34	Fracture Rank 2
102.2	61	34	Fracture Rank 2
102.3	76	38	Fracture Rank 2
102.4	102	34	Fracture Rank 2
102.5	103	33	Fracture Rank 3
102.6	101	22	Fracture Rank 2
102.7	92	15	Fracture Rank 1
102.8	277	16	Fracture Rank 2
103.0	270	16	Fracture Rank 2
103.1	270	21	Fracture Rank 1
103.2	251	16	Fracture Rank 2
103.3	77	51	Fracture Rank 1
103.3	296	10	Fracture Rank 2
103.4	294	13	Fracture Rank 2
103.6	303	27	Fracture Rank 2
103.6	92	29	Fracture Rank 1
103.7	324	21	Fracture Rank 2
103.8	314	24	Fracture Rank 2
103.9	280	22	Fracture Rank 1
104.0	256	39	Fracture Rank 3
104.1	259	41	Fracture Rank 2
104.2	254	41	Fracture Rank 2
104.3	239	36	Fracture Rank 3
104.6	90	29	Fracture Rank 1
104.6	334	26	Fracture Rank 1
104.8	103	47	Fracture Rank 2
105.0	119	53	Fracture Rank 2

114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
105.2	117	50	Fracture Rank 2
105.4	130	44	Fracture Rank 2
105.6	99	41	Fracture Rank 2
105.8	224	20	Fracture Rank 1
105.8	224	21	Fracture Rank 1
106.2	230	16	Fracture Rank 1
106.3	106	44	Fracture Rank 2
106.4	104	43	Fracture Rank 1
106.5	229	23	Fracture Rank 1
106.6	130	44	Fracture Rank 1
106.8	221	19	Fracture Rank 1
107.4	140	60	Fracture Rank 1
107.7	88	76	Fracture Rank 1
107.9	116	61	Fracture Rank 1
108.2	280	82	Fracture Rank 1
108.6	340	45	Fracture Rank 1
108.8	330	36	Fracture Rank 1
108.9	332	39	Fracture Rank 1
109.0	323	43	Fracture Rank 1
109.1	305	46	Fracture Rank 2
109.3	309	53	Fracture Rank 1
109.4	275	14	Fracture Rank 1
109.4	305	57	Fracture Rank 3
109.8	325	58	Fracture Rank 1
110.4	62	12	Fracture Rank 1
110.8	299	43	Fracture Rank 1
111.4	309	50	Fracture Rank 2
111.6	317	34	Fracture Rank 2
112.4	100	59	Fracture Rank 2
113.2	175	30	Fracture Rank 1
114.2	284	24	Fracture Rank 1
114.7	339	33	Fracture Rank 2
114.9	139	53	Fracture Rank 1
115.7	147	31	Fracture Rank 1
116.1	329	29	Fracture Rank 2
116.6	177	49	Fracture Rank 1
117.0	315	23	Fracture Rank 1
117.7	128	33	Fracture Rank 1
118.1	333	27	Fracture Rank 1
118.9	330	21	Fracture Rank 1
119.5	297	19	Fracture Rank 1
119.8	170	41	Fracture Rank 2
120.0	145	35	Fracture Rank 2
120.3	174	48	Fracture Rank 1
120.4	183	47	Fracture Rank 1

114-MW61D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
122.8	300	62	Fracture Rank 1
123.4	299	69	Fracture Rank 2
123.9	272	34	Fracture Rank 1
124.2	286	60	Fracture Rank 1
124.5	296	59	Fracture Rank 1
124.8	304	64	Fracture Rank 3
125.2	317	58	Fracture Rank 2

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 12.8° West)
DIP ANGLE	Measured from Horizontal

**114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
92.0	178	15	Fracture Rank 3
92.1	318	41	Fracture Rank 2
92.3	308	38	Fracture Rank 1
92.5	304	40	Fracture Rank 2
92.6	306	33	Fracture Rank 1
92.8	312	31	Fracture Rank 1
93.0	304	40	Fracture Rank 2
93.1	309	46	Fracture Rank 1
93.6	330	12	Fracture Rank 1
94.3	315	25	Fracture Rank 1
94.4	316	15	Fracture Rank 2
94.8	303	17	Bedding
94.9	313	18	Fracture Rank 1
95.0	297	15	Fracture Rank 1
95.1	300	15	Bedding
95.3	100	66	Fracture Rank 1
95.4	329	19	Fracture Rank 1
95.5	302	17	Bedding
95.6	113	63	Fracture Rank 1
95.6	307	16	Bedding
95.8	342	19	Fracture Rank 1
96.0	324	21	Fracture Rank 1
96.1	306	20	Bedding
96.2	304	22	Fracture Rank 2
96.4	292	22	Bedding
96.5	295	21	Fracture Rank 1
96.7	299	19	Bedding
96.8	282	14	Fracture Rank 1
97.0	296	15	Fracture Rank 1
97.7	94	74	Fracture Rank 1
99.0	295	17	Bedding
99.1	11	8	Fracture Rank 1
99.5	300	20	Bedding
99.8	303	19	Bedding
100.0	303	17	Fracture Rank 1

114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
100.2	300	17	Bedding
100.2	311	18	Bedding
100.6	309	19	Bedding
100.7	300	15	Bedding
100.9	303	20	Bedding
101.4	304	18	Bedding
101.6	302	21	Bedding
101.8	304	18	Bedding
102.1	302	18	Bedding
102.3	300	18	Bedding
102.3	296	17	Bedding
102.6	298	18	Bedding
102.7	299	18	Bedding
102.9	301	17	Bedding
103.1	298	17	Bedding
103.4	304	18	Bedding
103.6	299	19	Bedding
103.9	299	16	Bedding
104.1	296	19	Bedding
104.1	107	65	Fracture Rank 1
104.4	300	19	Bedding
105.4	267	17	Fracture Rank 1
106.0	330	13	Fracture Rank 1
106.2	310	16	Bedding
106.4	313	14	Fracture Rank 1
106.6	295	16	Bedding
106.8	298	15	Bedding
107.0	299	15	Bedding
107.2	298	14	Bedding
107.3	300	16	Bedding
107.5	294	16	Bedding
107.6	109	77	Fracture Rank 1
107.6	322	13	Fracture Rank 2
107.7	293	18	Bedding
108.0	312	15	Fracture Rank 1
108.1	307	13	Fracture Rank 2
108.3	293	16	Bedding
108.5	295	17	Bedding
108.7	298	15	Bedding
108.8	297	17	Bedding
109.0	297	15	Bedding
109.1	298	15	Bedding
109.2	296	16	Bedding
109.5	322	18	Fracture Rank 2
110.0	106	82	Fracture Rank 1

114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
111.0	289	16	Bedding
111.4	299	18	Bedding
111.7	290	17	Bedding
111.9	285	15	Fracture Rank 1
112.0	299	17	Bedding
112.1	290	11	Fracture Rank 2
112.2	303	15	Bedding
112.4	308	16	Bedding
112.9	290	13	Fracture Rank 1
113.6	308	18	Fracture Rank 1
113.6	300	19	Bedding
114.0	81	83	Fracture Rank 1
114.3	299	16	Bedding
114.3	300	17	Bedding
114.7	307	16	Bedding
114.9	329	16	Fracture Rank 1
115.2	304	17	Bedding
115.5	310	19	Bedding
115.6	305	14	Fracture Rank 1
115.7	298	15	Fracture Rank 2
116.0	302	20	Bedding
116.2	99	74	Fracture Rank 1
116.2	271	9	Fracture Rank 1
116.3	292	23	Fracture Rank 2
116.4	296	20	Bedding
116.5	299	19	Bedding
116.7	290	17	Fracture Rank 1
116.8	282	14	Fracture Rank 2
116.9	291	15	Bedding
117.1	290	16	Bedding
117.2	291	17	Fracture Rank 2
117.4	292	13	Bedding
117.6	270	17	Fracture Rank 1
118.1	294	11	Bedding
118.7	279	17	Fracture Rank 1
119.0	293	12	Bedding
119.2	297	26	Fracture Rank 1
119.3	286	23	Fracture Rank 2
119.4	286	12	Fracture Rank 2
119.8	226	34	Fracture Rank 1
119.9	301	59	Fracture Rank 1
119.9	226	31	Fracture Rank 1
120.1	123	84	Fracture Rank 3
120.2	271	63	Fracture Rank 1
120.7	262	66	Fracture Rank 2

114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
120.7	247	72	Fracture Rank 2
121.2	312	49	Fracture Rank 2
121.4	323	44	Fracture Rank 2
121.8	314	46	Fracture Rank 2
122.0	272	28	Fracture Rank 1
122.2	282	22	Fracture Rank 2
122.2	314	60	Fracture Rank 2
122.3	181	72	Fracture Rank 1
122.4	143	26	Fracture Rank 1
122.7	263	33	Fracture Rank 1
122.9	294	27	Fracture Rank 1
123.0	290	17	Fracture Rank 1
123.1	289	20	Fracture Rank 2
123.4	290	19	Bedding
123.4	4	81	Fracture Rank 2
123.5	282	29	Fracture Rank 2
123.8	277	27	Fracture Rank 1
124.2	289	14	Bedding
124.5	281	72	Fracture Rank 1
124.6	327	17	Fracture Rank 1
125.0	281	20	Bedding
125.1	280	21	Fracture Rank 2
125.3	286	16	Fracture Rank 1
125.6	258	26	Fracture Rank 1
125.8	272	24	Fracture Rank 1
126.1	284	20	Fracture Rank 1
126.1	277	55	Fracture Rank 1
126.2	301	13	Bedding
126.4	288	13	Bedding
126.6	290	14	Bedding
126.7	301	12	Fracture Rank 2
126.8	288	15	Bedding
127.0	299	13	Fracture Rank 2
127.1	297	13	Bedding
127.3	296	14	Bedding
127.5	296	14	Fracture Rank 2
127.7	308	12	Fracture Rank 2
128.0	109	80	Fracture Rank 1
128.2	112	78	Fracture Rank 1
128.5	299	14	Bedding
129.7	276	21	Fracture Rank 2
129.8	300	15	Bedding
130.5	313	11	Bedding
130.7	311	11	Bedding
131.3	178	79	Fracture Rank 1

114-MW66D DEEPENED - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
131.3	296	13	Bedding
132.3	292	13	Bedding
132.5	303	14	Bedding
132.6	300	16	Bedding
132.7	95	73	Fracture Rank 1
132.7	296	18	Fracture Rank 1
133.0	292	14	Bedding
133.2	288	14	Bedding
133.2	300	16	Bedding
133.5	298	15	Bedding
133.7	286	16	Bedding
133.9	293	15	Fracture Rank 1
134.1	289	13	Bedding
134.2	289	14	Bedding
134.3	288	23	Fracture Rank 1
134.4	287	13	Bedding
134.5	284	12	Fracture Rank 1
134.5	292	10	Fracture Rank 2
134.7	310	14	Fracture Rank 2
134.9	301	16	Fracture Rank 2
135.9	287	15	Bedding
137.0	302	15	Bedding
137.1	302	10	Bedding
137.2	332	22	Fracture Rank 1
137.3	171	6	Fracture Rank 1
137.4	288	15	Bedding
137.6	294	14	Bedding
137.8	288	13	Bedding
137.9	292	15	Fracture Rank 2
138.0	292	19	Fracture Rank 2
138.1	290	15	Bedding
138.3	310	18	Fracture Rank 1
138.4	301	15	Fracture Rank 1
138.5	301	21	Fracture Rank 2
138.7	296	16	Bedding
139.0	351	21	Fracture Rank 1
139.1	299	11	Bedding
139.2	293	15	Bedding

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW71D - TABLE OF BEDROCK STRUCTURES	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19, 2021
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 12.8° West)
DIP ANGLE	Measured from Horizontal

**114-MW71D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
117.6	209	44	Fracture Rank 2
118.0	232	26	Fracture Rank 2
118.2	227	46	Fracture Rank 2
118.8	84	54	Fracture Rank 2
119.2	128	53	Fracture Rank 3
119.4	123	44	Fracture Rank 2
119.6	132	39	Fracture Rank 2
119.8	142	24	Fracture Rank 2
120.1	128	62	Fracture Rank 2
120.2	184	55	Fracture Rank 2
120.4	164	39	Fracture Rank 2
120.7	162	30	Fracture Rank 2
120.8	149	30	Fracture Rank 2
121.0	203	55	Fracture Rank 2
121.0	152	34	Fracture Rank 2
121.1	140	26	Fracture Rank 1
121.2	128	25	Fracture Rank 1
121.4	187	28	Fracture Rank 2
121.7	188	56	Fracture Rank 2
121.9	195	31	Fracture Rank 2
122.0	360	23	Fracture Rank 2
122.2	153	21	Fracture Rank 2
122.4	109	30	Fracture Rank 3
122.6	111	37	Fracture Rank 2
122.7	324	49	Fracture Rank 1
122.8	97	31	Fracture Rank 2
123.0	84	20	Fracture Rank 1
123.2	65	25	Fracture Rank 2
123.3	70	25	Fracture Rank 1
123.5	81	25	Fracture Rank 1
123.7	92	24	Fracture Rank 2
123.9	131	25	Fracture Rank 1
124.3	136	63	Fracture Rank 2
124.6	127	56	Fracture Rank 3
125.0	132	77	Fracture Rank 2

114-MW71D - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
125.1	124	27	Fracture Rank 1
125.5	89	27	Fracture Rank 1
125.6	145	64	Fracture Rank 2
125.9	73	36	Fracture Rank 2
126.0	76	38	Fracture Rank 3
126.1	79	37	Fracture Rank 2
126.3	109	19	Fracture Rank 2
126.4	339	27	Fracture Rank 1
126.4	310	52	Fracture Rank 1
126.6	128	17	Fracture Rank 1
126.7	306	59	Fracture Rank 2
126.9	300	64	Fracture Rank 1
127.0	304	63	Fracture Rank 1
127.1	81	38	Fracture Rank 2
127.3	305	64	Fracture Rank 1
127.5	306	67	Fracture Rank 1
127.7	303	67	Fracture Rank 1
127.9	302	64	Fracture Rank 1
128.1	294	60	Fracture Rank 1
128.6	125	31	Fracture Rank 1
130.0	280	69	Fracture Rank 1
131.8	116	30	Fracture Rank 1
132.0	293	69	Fracture Rank 1
132.1	113	27	Fracture Rank 2
132.3	108	27	Fracture Rank 2
132.4	98	30	Fracture Rank 1
132.5	296	60	Bedding
133.0	312	64	Fracture Rank 1
133.2	309	62	Fracture Rank 2
133.2	37	71	Fracture Rank 1
133.8	306	60	Bedding
134.0	304	60	Fracture Rank 1
134.3	305	61	Fracture Rank 2
134.4	302	60	Bedding
134.4	140	24	Fracture Rank 1
134.5	302	59	Fracture Rank 1
134.7	142	31	Fracture Rank 2
134.7	30	76	Fracture Rank 1
134.7	302	60	Fracture Rank 2
134.9	303	59	Fracture Rank 2
135.0	299	62	Fracture Rank 1
135.1	302	62	Fracture Rank 2
135.2	300	63	Bedding
135.3	294	65	Bedding
135.5	301	67	Fracture Rank 1

114-MW71D - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
135.7	299	64	Bedding
135.8	302	65	Fracture Rank 2
135.9	298	64	Bedding
136.5	317	58	Fracture Rank 1
136.6	140	37	Fracture Rank 1
137.1	116	23	Fracture Rank 2
137.2	116	31	Fracture Rank 3
137.3	109	31	Fracture Rank 2
137.4	139	42	Fracture Rank 2
137.6	68	33	Fracture Rank 2
137.9	131	35	Fracture Rank 1
138.0	135	35	Fracture Rank 2
138.3	90	53	Fracture Rank 2
138.4	156	32	Fracture Rank 1
138.4	101	51	Fracture Rank 2
138.4	199	60	Fracture Rank 1
138.6	125	31	Fracture Rank 1
138.7	108	32	Fracture Rank 2
139.1	110	22	Fracture Rank 2
139.2	46	56	Fracture Rank 2
139.2	119	22	Fracture Rank 2
139.5	310	59	Fracture Rank 2
139.6	105	36	Fracture Rank 2
139.6	305	61	Fracture Rank 2
139.7	108	30	Fracture Rank 1
139.7	306	61	Fracture Rank 1
139.9	116	34	Fracture Rank 2
140.0	117	34	Fracture Rank 1
140.1	119	32	Fracture Rank 1
140.2	304	65	Fracture Rank 2
140.2	122	38	Fracture Rank 2
140.4	295	62	Bedding
140.4	113	35	Fracture Rank 2
140.6	138	38	Fracture Rank 1
140.7	137	36	Fracture Rank 2
141.0	127	39	Fracture Rank 1
141.1	283	58	Bedding
141.2	280	40	Fracture Rank 2
141.4	108	39	Fracture Rank 2
141.4	289	43	Fracture Rank 2
141.6	105	34	Fracture Rank 2
141.9	308	49	Fracture Rank 1
142.2	112	37	Fracture Rank 2

HAGER-RICHTER GEOSCIENCE, INC.	
114-MW72D - TABLE OF BEDROCK STRUCTURES	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	November 19 & 22, 2021
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 12.8° West)
DIP ANGLE	Measured from Horizontal

**114-MW72D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
103.0	304	24	Fracture Rank 2
103.0	136	74	Fracture Rank 2
103.1	245	28	Fracture Rank 1
103.1	307	71	Fracture Rank 2
103.7	154	75	Fracture Rank 1
104.1	318	24	Fracture Rank 2
104.4	311	40	Fracture Rank 2
104.5	314	32	Fracture Rank 1
104.8	288	28	Fracture Rank 2
105.1	310	32	Fracture Rank 2
105.3	311	38	Fracture Rank 2
105.3	302	58	Fracture Rank 1
105.6	323	25	Fracture Rank 1
105.8	317	34	Fracture Rank 2
106.0	308	29	Fracture Rank 2
106.3	329	57	Fracture Rank 1
106.4	309	25	Bedding
106.6	319	39	Fracture Rank 1
106.9	293	30	Fracture Rank 1
107.2	306	20	Bedding
107.5	303	43	Fracture Rank 2
107.8	303	17	Bedding
108.2	296	17	Bedding
108.7	302	18	Bedding
109.0	308	13	Fracture Rank 2
109.2	309	19	Bedding
109.4	310	20	Fracture Rank 2
109.6	301	18	Fracture Rank 2
109.6	304	17	Bedding
109.9	310	18	Bedding
110.1	313	7	Fracture Rank 2
110.3	301	18	Bedding
110.3	110	83	Fracture Rank 1
110.4	302	19	Bedding
110.6	306	18	Bedding

114-MW72D - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
110.6	180	38	Fracture Rank 1
110.9	283	21	Fracture Rank 1
111.0	305	18	Bedding
111.2	288	20	Fracture Rank 1
111.6	179	79	Fracture Rank 1
112.0	299	19	Bedding
112.2	305	17	Bedding
112.4	105	79	Fracture Rank 1
112.9	192	82	Fracture Rank 1
113.4	306	17	Fracture Rank 2
113.8	120	75	Fracture Rank 1
114.2	303	13	Bedding
114.3	107	76	Fracture Rank 1
115.1	299	17	Bedding
115.8	303	16	Bedding
115.9	297	16	Bedding
116.0	296	16	Bedding
116.1	304	16	Bedding
116.4	330	15	Fracture Rank 2
116.6	335	30	Fracture Rank 1
116.7	297	15	Bedding
116.9	321	30	Fracture Rank 1
117.1	315	18	Bedding
117.3	303	16	Fracture Rank 1
117.4	305	18	Bedding
117.4	299	15	Fracture Rank 1
117.5	308	16	Fracture Rank 1
117.7	306	16	Bedding
118.0	303	19	Bedding
118.2	207	81	Fracture Rank 2
118.2	301	17	Bedding
118.3	297	18	Bedding
119.2	219	10	Fracture Rank 1
119.3	290	20	Bedding
120.0	296	19	Bedding
120.4	309	18	Bedding
120.8	309	16	Bedding
120.9	308	14	Bedding
121.0	304	16	Bedding
121.2	304	15	Bedding
121.4	306	16	Bedding
121.7	306	16	Bedding
122.1	303	15	Bedding
122.4	305	14	Bedding
122.5	307	16	Bedding

114-MW72D - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
125.0	333	14	Bedding
125.4	335	24	Fracture Rank 1
126.3	317	15	Bedding
126.6	315	16	Bedding
126.7	305	12	Bedding

From: Robert Garfield <rob@hager-richter.com>  
Sent: Monday, February 21, 2022 5:27 PM  
To: Schuele, Frederik; Gleason, Shannon; Folan, Daniel; Spronz, William  
Cc: Jeff Reid; Nick DeCristofaro; Mikko Aarnio  
Subject: [EXTERNAL] PPG Site 114 - GAG Sites - Jersey City, NJ - Borehole Geophysical Logging - Data Report 2022-02  
Attachments: 114-MW4D Deepened - Table of Bedrock Structures.xlsx; 114-MW61D Deepened - Table of Bedrock Structures.xlsx; 114-MW66D Deepened - Table of Bedrock Structures.xlsx; 114-MW71D - Table of Bedrock Structures.xlsx; 114-MW72D - Table of Bedrock Structures.xlsx; PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report 2022-02.pdf; PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Log Data - 2022-02.xlsx

Attached please find the data report for the borehole geophysical logging conducted in the 5 boreholes listed below at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey in late 2021. The data report consists of the borehole geophysical logs, bedrock structure statistics plots, tables of bedrock structures, and the borehole geophysical logging figures. The tables of bedrock structures and the linear logging data are also provided attached to this email in Microsoft Excel format as requested.

- 114-MW4D Deepened
- 114-MW61D Deepened
- 114-MW66D Deepened
- 114-MW71D
- 114-MW72D

The borehole geophysical logging conducted in boreholes 114-MW4D, 114-MW61D, and 114-MW66D were each conducted in 2 phases. The first phase of logging each of these 3 boreholes was conducted September 2020 through January 2021. Each borehole was then deepened by 15-30 feet before the second phase of logging was conducted in November 2021. Boreholes 114-MW71D and 114-MW72D were both newly drilled boreholes logged during a single phase of logging in November 2021.

The borehole geophysical logging program consisted of the following in the logged boreholes.

- Optical Televiwer (OTV)
- Acoustic Televiwer (ATV)
- Acoustic Caliper
- Natural Gamma Ray
- Spontaneous Potential (SP)
- Single Point Resistance (SPR)
- Fluid Temperature
- Fluid Conductivity
- Heat Pulse Flow Meter (HPFM) Under Ambient Conditions
- HPFM Under Stressed (Low Constant Rate Pumping) Conditions

[Explanation of the Borehole Geophysical Data Interpretation and Presentation](#)

The datum for depths in this report is the top of the 6-inch steel casing at the location of each borehole at the time of logging in November 2021 except for borehole 114-MW61D. The top of the 6-inch steel casing for 114-MW61D was cut between the first and second phases of logging. Depths in this report for borehole 114-MW61D are referenced to the top of the 6-inch steel casing during the first phase of logging in January 2021 as specified by AECOM. The depths of bedrock structures are reported as the average depths of the top and bottom intersections of the bedrock structures and the borehole wall. The orientations of bedrock structures are reported as the dip azimuth (dip direction) and dip angle of each structure, as shown in the Televiwer Explanation Figure. The OTV, ATV, and bedrock structure dip azimuth data are referenced to true north using a magnetic declination of 12.8° west and the bedrock structure dip angle data are reported from horizontal. Please note that the bedrock structure dip azimuth data are perpendicular to strike as used commonly by geologists.

Bedrock structures detected in the televiwer (OTV & ATV) data are grouped into four categories (Fracture Rank 1, Fracture Rank 2, Fracture Rank 3, and Bedding) and are shown as color-coded lines and symbols on the structure projection plots and tadpole plots. The Key to Bedrock Structure Categories figure describes the bedrock structure categories and associated colors and tadpole shapes. The Tadpole Explanation Figure explains how to "read" the tadpole plots. Fracture Rank 1 consists of minor fractures that are not distinct and may not be continuous around the borehole. Fracture Rank 2 consists of intermediate fractures that are distinct and continuous around the borehole with little or no apparent aperture. Fracture Rank 3 consists of major fractures that are distinct and continuous around the borehole with apparent aperture. The Bedding category consists of planar geologic structures in the bedrock interpreted as bedding. The bedding category is only used to characterize bedrock structures in portions of the boreholes in sedimentary bedrock where bedding is detected.

The data report consist of the following.

- o Borehole Geophysical Logging Figures

- Figure 1. Key to bedrock structure categories

- Figure 2. Tadpole plot explanation figure

- Figure 3. Televiwer explanation figure

- o Borehole Geophysical Logs – The borehole geophysical logs are provided at a scale of 1-inch to 2.5-feet, meant to be printed on portrait 11" x 17" paper, and consist of the following.

<u>Track #</u>	<u>Log &amp; Description</u>
1.	OTV Image
2.	Depth
3.	ATV Amplitude
4.	ATV Travel Time
	Structure Projection – bedrock structure interpretation plotted in projection view
5.	Acoustic Caliper – borehole diameter in inches
	Tadpole Plot – bedrock structure interpretation plotted as tadpoles
6.	Natural Gamma Ray, SP, & SPR
7.	Depth
8.	Fluid Temperature & Fluid Conductivity
9.	HPFM Under Ambient & Pumping Conditions
	Borehole Flow Interpretation

- o Summary of Borehole Flow Tables – The summary of borehole flow tables summarize the borehole flow conditions in each borehole individually, are meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consists of the following.

<u>Column #</u>	<u>Description</u>
-----------------	--------------------

1. Depth
2. Comments

- o Bedrock Fracture Statistics Plots (Primarily Igneous Bedrock with Fractures Only: 114-MW4D Deepened, 114-MW61D Deepened) – The statistics plots consist of all detected bedrock structures in boreholes 114-MW4D Deepened and 114-MW61D Deepened individually, are meant to be printed on landscape 11" x 17" paper, and consist of the following.

<u>Track #</u>	<u>Description</u>
1.	Stereogram of Fractures – poles of fractures plotted on an equal area lower hemisphere stereogram
2.	Contoured Stereogram of Fractures – contours of poles of fractures plotted on an equal area lower hemisphere stereogram
3.	Dip Azimuth Rose Diagram of Fractures
4.	Dip Angle Histogram of Fractures

- o Bedrock Structure Statistics Plots (Primarily Sedimentary Bedrock with Fractures & Bedding: 114-MW66D Deepened, 114-MW71D, 114-MW72D) – The statistics plots consist of all detected bedrock structures in boreholes 114-MW66D Deepened, 114-MW71D, and 114-MW72D individually, are meant to be printed on landscape 11" x 17" paper, and consist of the following.

<u>Track #</u>	<u>Description</u>
1.	Stereogram of Fractures – poles of fractures plotted on an equal area lower hemisphere stereogram
2.	Dip Azimuth Rose Diagram of Fractures
3.	Dip Angle Histogram of Fractures
4.	Stereogram of Bedding – poles of bedding plotted on an equal area lower hemisphere stereogram
5.	Dip Azimuth Rose Diagram of Bedding
6.	Dip Angle Histogram of Bedding

- o Tables of Bedrock Structures – The tables of bedrock structures consist of all detected bedrock structures (fractures & bedding) in each borehole individually, are meant to be printed on standard portrait 8.5" x 11" paper, and consists of the following.

<u>Column #</u>	<u>Description</u>
1.	Depth
2.	Bedrock Structure Dip Azimuth
3.	Bedrock Structure Dip Angle
4.	Bedrock Structure Category

## Borehole Geophysical Logging Results

### General

Based on the borehole geophysical logging data, primarily the OTV and natural gamma ray data, the bedrock encountered in the open-hole portions of boreholes 114-MW4D and 114-MW61D appears to primarily be igneous bedrock, possibly diabase based on information provided by AECOM, above an apparent transition from igneous bedrock to sedimentary bedrock near the bottom of these 2 boreholes at approximately 119.6 feet in 114-MW4D and at approximately 119.4 feet in 114-MW61D. The bedrock encountered in the open-hole portions of boreholes 114-MW66D, 114-MW71D, and 114-MW72D appears to be primarily or fully in sedimentary bedrock, likely from the Lockatong Formation based on information provided by AECOM.

## Summary of Borehole Flow

Vertical flow was not detected in any of the 5 logged boreholes with the HPFM under ambient conditions. However, flow was detected in all 5 boreholes with the HPFM under stressed (low constant rate pumping) conditions. The HPFM data acquired under stressed conditions were acquired while water was pumped from the boreholes with a pump set in the casing of each borehole. Below is a summary of the approximate depths where flow was detected with the HPFM into and up each borehole to the pump from hydraulically transmissive bedrock fractures under pumping conditions.

### 114-MW4D Deepened- Summary of Borehole Flow Under Pumping Conditions

Depth (Feet)	Comments
40.6	Water Level
49.0 - 50.0	Location of Pump for HPFM Under Pumping Conditions
50.0 - 85.6	flow up the borehole in the casing at 0.02 gpm under pumping conditions
85.6	Bottom of the 6-Inch Steel Casing
85.6 - 113.7	flow up the borehole at 0.02 gpm under pumping conditions
113.7 - 120.0	minor flow into & up the borehole under pumping conditions
120.0 - 121.9	no flow detected under pumping conditions
121.9	Bottom of the Borehole (based on the geophysical logging)

### 114-MW61D Deepened - Summary of Borehole Flow Under Pumping Conditions

Depth (Feet)	Comments
11.7	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 87.4	flow up the borehole in the casing at 0.01 gpm under pumping conditions
87.4	Bottom of the 6-Inch Steel Casing
87.4 - 91.6	minor flow into & up the borehole under pumping conditions
91.6 - 126.5	no flow detected under pumping conditions
126.5	Bottom of the Borehole (based on the geophysical logging)

### 114-MW66D Deepened - Summary of Borehole Flow Under Pumping Conditions

Depth (Feet)	Comments
8.5	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 91.8	flow up the borehole in the casing at 0.02 gpm under pumping conditions
91.8	Bottom of the 6-Inch Steel Casing
91.8 - 93.1	minor flow into & up the borehole under pumping conditions
93.1 - 117.1	flow up the borehole at 0.01 gpm under pumping conditions
117.1 - 125.0	minor flow into & up the borehole under pumping conditions
125.0 - 141.4	no flow detected under pumping conditions
141.4	Bottom of the Borehole (based on the geophysical logging)

### 114-MW71D - Summary of Borehole Flow Under Pumping Conditions

Depth (Feet)	Comments
50.5	Water Level
57.0 - 58.0	Location of Pump for HPFM Under Pumping Conditions

58.0 - 117.1	flow up the borehole in the casing at 0.03 gpm under pumping conditions
117.1	Bottom of the 6-Inch Steel Casing
117.1 - 128.7	minor flow into & up the borehole under pumping conditions
128.7 - 136.9	flow up the borehole at 0.01 gpm under pumping conditions
136.9 - 140.4	minor flow into & up the borehole under pumping conditions
140.4 - 142.2	no flow detected under pumping conditions
142.2	Bottom of the Borehole (based on the geophysical logging)

114-MW72D - Summary of Borehole Flow Under Pumping Conditions

Depth (Feet)	Comments
6.2	Water Level
19.0 - 20.0	Location of Pump for HPFM Under Pumping Conditions
20.0 - 102.8	flow up the borehole in the casing at 0.01 gpm under pumping conditions
102.8	Bottom of the 6-Inch Steel Casing
102.8 - 106.0	minor flow into & up the borehole under pumping conditions
106.0 - 127.2	no flow detected under pumping conditions
127.2	Bottom of the Borehole (based on the geophysical logging)

Summary of Bedrock Structure Statistics

The bedrock structure orientations and statistics are plotted and reported on the bedrock structure statistics plots. Based on the televiewer (OTV & ATV) data from the logged boreholes, the majority of the bedrock fractures detected in the sedimentary bedrock at the site are approximately parallel to the bedrock bedding in the logged boreholes. The number of bedrock fractures and bedding detected and the most prominent orientations (dip azimuths and dip angles) of these bedrock fractures and bedding are reported in the tables below.

Summary of Bedrock Fracture Statistics  
for Boreholes 114-MW4D & 114-MW61D

Borehole ID & Date Logged	Structure Type	Number of Structures	Most Prominent Bedrock Fracture Dip Azimuths	Most Prominent Bedrock Fracture Dip Angles
114-MW4D Deepened (November 22, 2021)	Fractures	194	primary: east to south (75° - 180°) secondary: northwest (285° - 345°)	primary: 25° - 55° from horizontal secondary: 40° - 75° from horizontal
114-MW61D Deepened (November 19, 2021)	Fractures	177	primary: east-southeast (90° - 135°) secondary: northwest (270° - 330°)	primary: 25° - 60° from horizontal secondary: 15° - 40° from horizontal

Summary of Bedrock Structure (Fractures & Bedding) Statistics  
for Boreholes 114-MW66D Deepened, 114-MW71D, 114-MW72D

Borehole ID & Date Logged	Structure Type	Number of Structures	Most Prominent Bedrock Structure Dip Azimuths	Most Prominent Bedrock Structure Dip Angles
114-MW66D Deepened (November 19, 2021)	Fractures	108	primary: west-northwest (270° - 315°) secondary: east-southeast (90° - 120°)	primary: 10° - 25° from horizontal secondary: 65° - 90° from horizontal
	Bedding	100	northwest (285° - 315°)	10° - 20° from horizontal
114-MW71D (November 19, 2021)	Fractures	114	primary: southeast (105° - 135°) secondary: northwest (300° - 315°)	primary: 25° - 40° from horizontal secondary: 55° - 70° from horizontal
	Bedding	9	northwest (285° - 300°)	60° - 65° from horizontal
114-MW72D (November 19 & 22, 2021)	Fractures	42	northwest (300° - 315°)	10° - 40° from horizontal
	Bedding	43	northwest (300° - 315°)	15° - 20° from horizontal

If you have any questions or would like additional information, feel free to contact us at your convenience.

Thanks,  
Rob

ROBERT GARFIELD, P.G.  
Owner | Principal Borehole Geophysicist

## **HRGS**

*Geophysics for the Engineering & Environmental Communities*

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**BOREHOLE GEOPHYSICAL LOGGING – DATA REPORT  
BOREHOLES 114-MW73D & 114-MW74D  
PPG SITE 114 – GARFIELD AVENUE GROUP SITES  
JERSEY CITY, NEW JERSEY**

*Prepared for:*

AECOM  
Two City Center, Suite 200  
Portland, Maine 04101

Prepared by:

Hager-Richter Geoscience  
2 Industrial Way S/2  
Atkinson, New Hampshire 03811

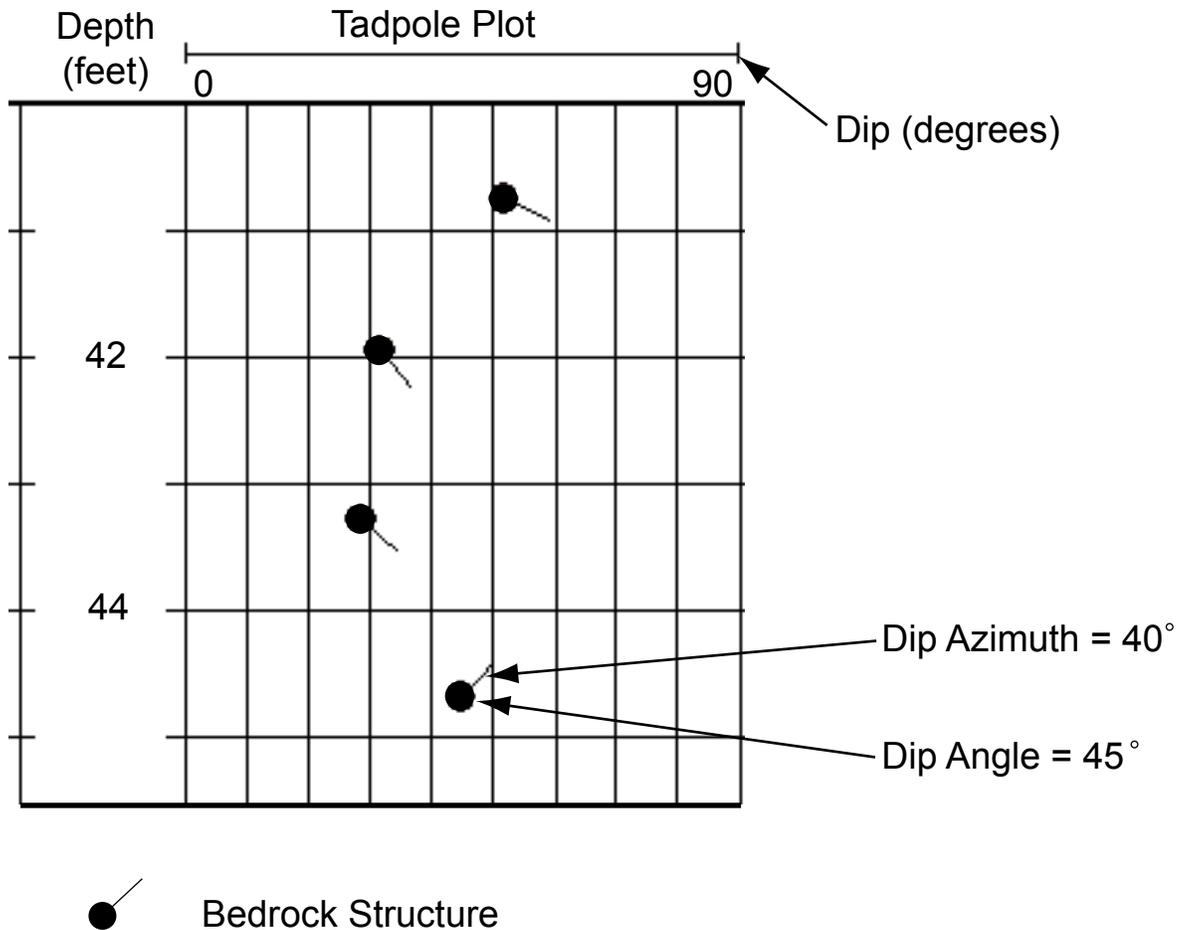
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Fords, New Jersey 08863

File 19RG66  
June 2024

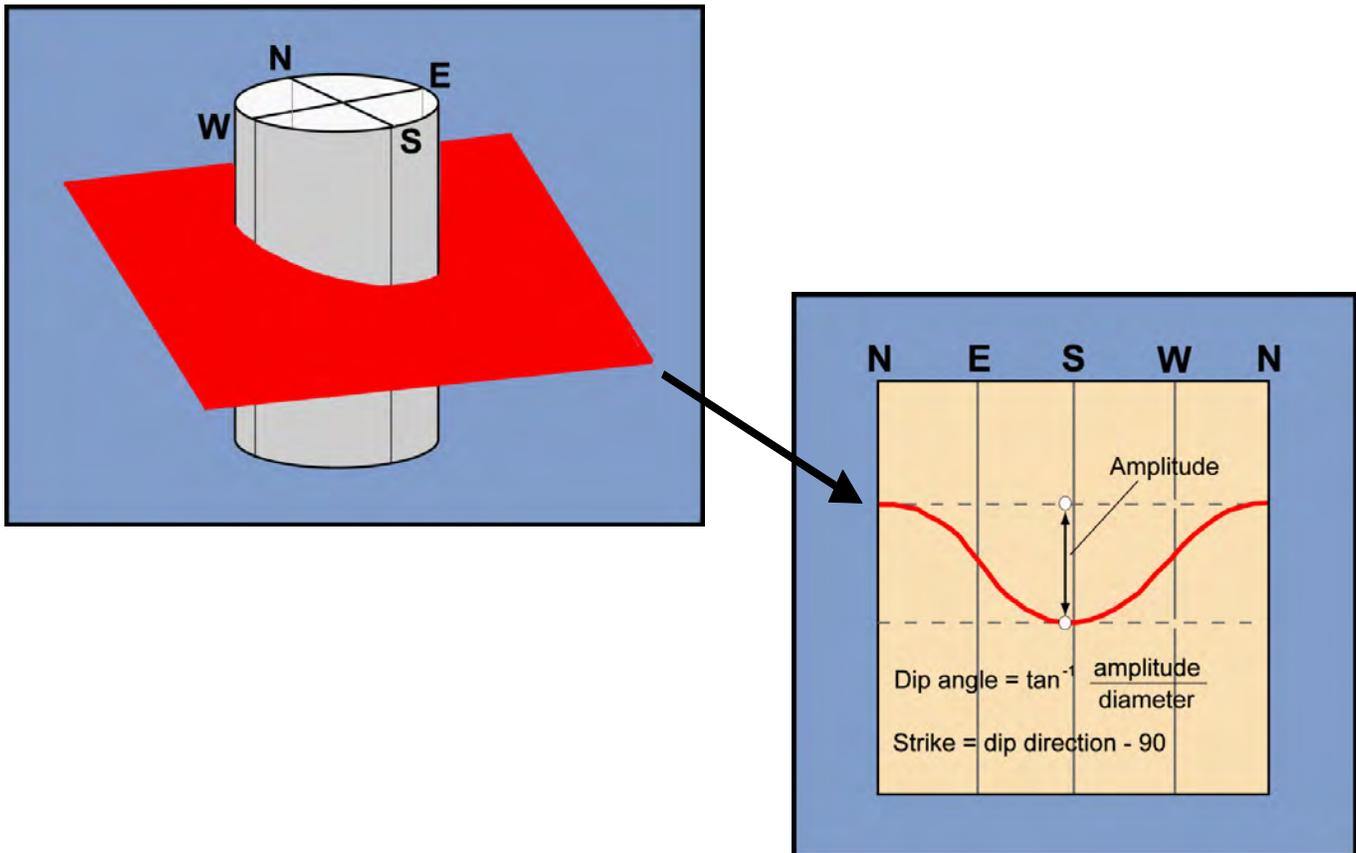
© 2024 Hager-Richter Geoscience, Inc.

Tadpole	Structure Category (Symbol Color)	Description
	Bedding (Brown)	Planar geologic feature interpreted as bedding
	Fracture Rank 1 (Light Blue)	Minor Fracture - not distinct and may not be continuous around the borehole
	Fracture Rank 2 (Blue)	Intermediate Fracture - distinct and continuous around the borehole with little or no apparent aperture
	Fracture Rank 3 (Red)	Major Fracture - distinct and continuous around the borehole with apparent aperture

**Figure 1.** Key to bedrock structure categories.



**Figure 2.** Tadpole plot explanation. The orientation of the bedrock structures is graphically displayed by a tadpole consisting of a circle, the head, and a line, the tail. The position of the head, left to right on the tadpole plot, gives the dip angle of the structure. The left side of the track indicates a dip angle of  $0^\circ$ , and the right side of the track indicates a dip angle of  $90^\circ$  from horizontal. The orientation of the tail gives the dip azimuth of the structure and can be read like a compass. The tail pointing directly up is  $0^\circ$ , north.



**Figure 3.** Televiewer explanation. The image on the left depicts a planar structure in red, such as a fracture or bedding plane, intersected by a borehole. The image on the right depicts the same structure unwrapped as it would be displayed in an optical televiewer (OTV) or acoustic televiewer (ATV) log.

Figure modified from: Garfield, R.L., Day-Lewis, F.D., Gray, M.B., Johnson, C.D., Williams, J.H. and Day-Lewis, A.D.F., 2003, Fractured-Rock Aquifer Characterization within a Regional Geologic Context: Results from the Bucknell University Hydrogeophysics Test Site, GSA Northeastern Section, 38th Annual Meeting, Paper No. 25-19.

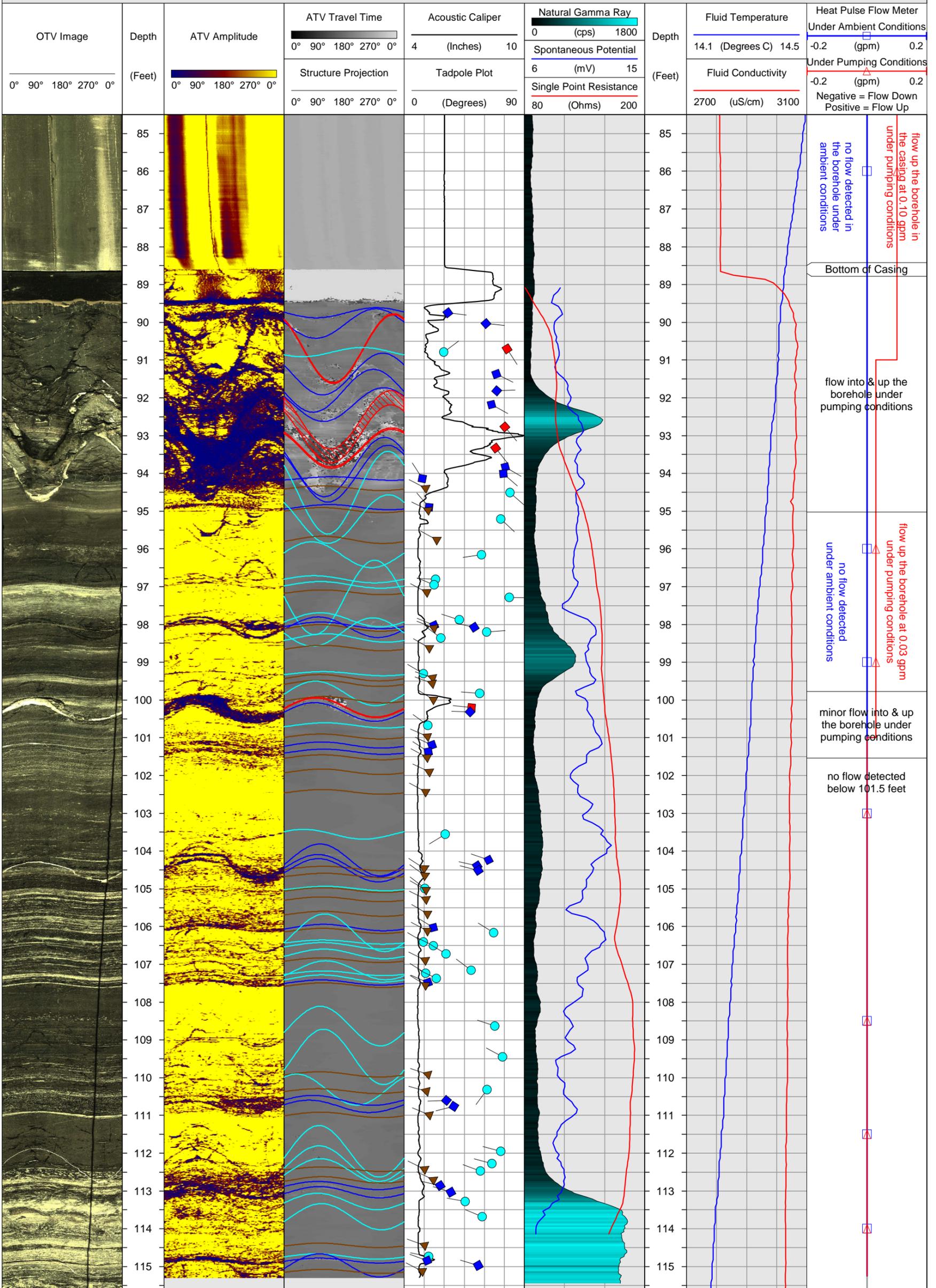
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Alex Collier  
PROJECT REP(S) ON-SITE: Zach Bartram  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing  
TOP OF CASING: 2.0 Feet Above the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 13° West)  
BOREHOLE DIAMETER: 5 Inches  
WATER LEVEL DEPTH: 6.5 Feet

STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3
- ▲ Bedding

114-MW73D - Borehole Geophysical Logs



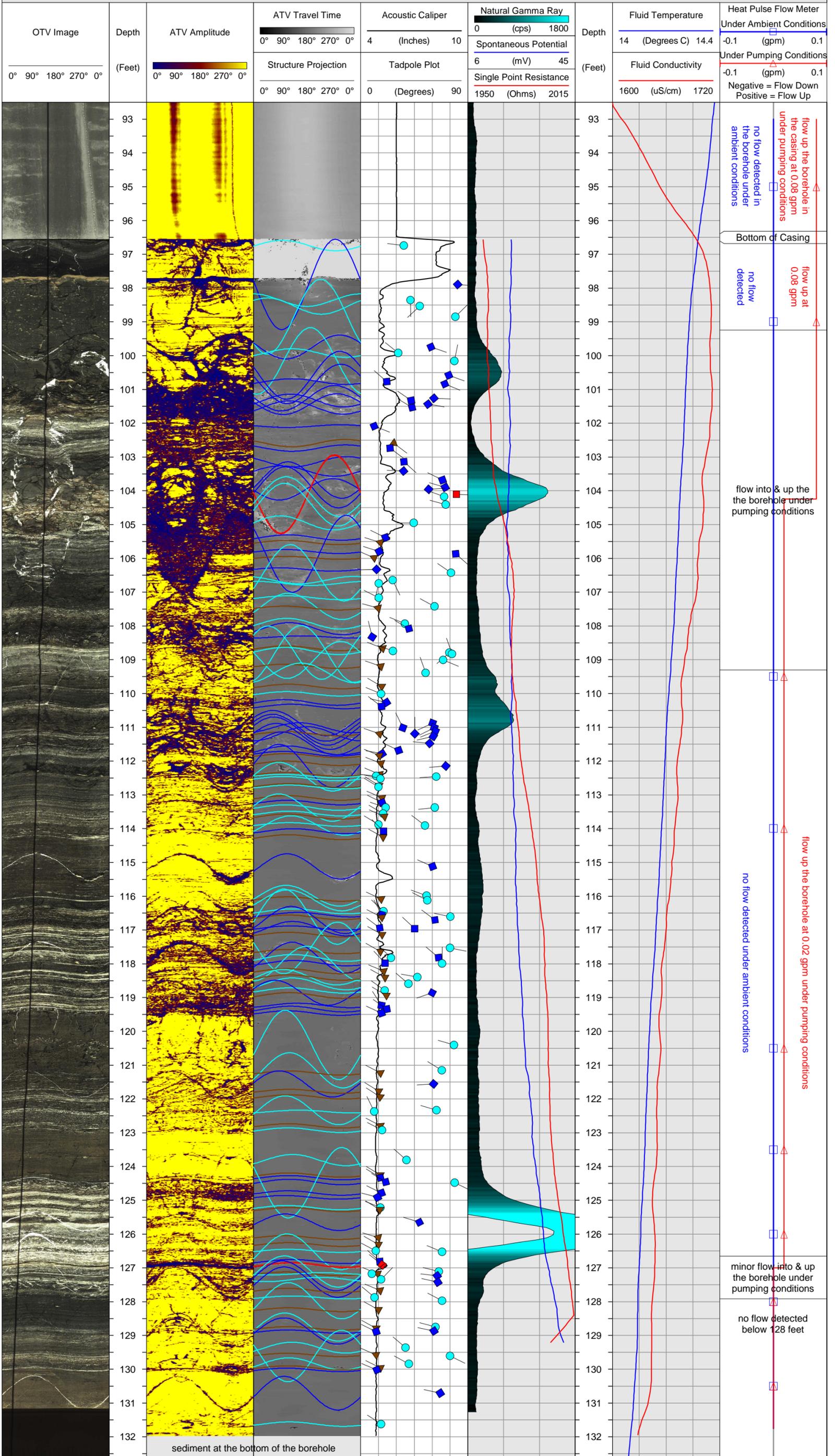
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey  
LOGGING GEOPHYSICIST(S): Nick DeCristofaro & Alex Collier  
PROJECT REP(S) ON-SITE: Zach Bartram  
LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
LOG DATUM: Top of the 6-Inch Steel Casing  
TOP OF CASING: 0.9 Feet Above the Ground Surface  
ORIENTATION REFERENCE: True North (Magnetic Declination = 13° West)  
BOREHOLE DIAMETER: 5 Inches  
WATER LEVEL DEPTH: 6.7 Feet

STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3
- ▲ Bedding

114-MW74D - Borehole Geophysical Logs



## HRGS

### HAGER-RICHTER GEOSCIENCE

#### 114-MW73D - Summary of Borehole Flow Under Ambient & Pumping Conditions

CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	February 5, 2024
LOG DATUM	Top of the 6-Inch Steel Casing

#### 114-MW73D - Summary of Borehole Flow Under Ambient & Pumping Conditions

Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
2.0	Ground Surface
6.5	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 88.6	flow up the borehole in the casing at 0.10 gpm under pumping conditions
88.6	Bottom of the 6-Inch Steel Casing
88.6 - 95.0	flow into & up the borehole under pumping conditions
95.0 - 99.8	flow up the borehole in the casing at 0.03 gpm under pumping conditions
99.8 - 101.5	minor flow into & up the borehole under pumping conditions
101.5 - 115.7	no flow detected under pumping conditions
115.7	Bottom of the Borehole (based on the geophysical logging)

# HRGS

## HAGER-RICHTER GEOSCIENCE

### 114-MW74D - Summary of Borehole Flow Under Ambient & Pumping Conditions

CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	February 5, 2024
LOG DATUM	Top of the 6-Inch Steel Casing

### 114-MW74D - Summary of Borehole Flow Under Ambient & Pumping Conditions

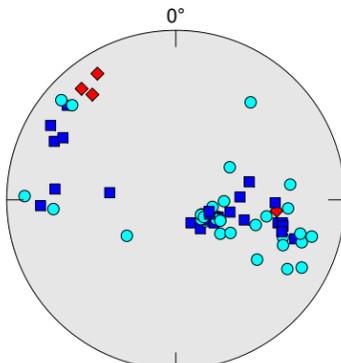
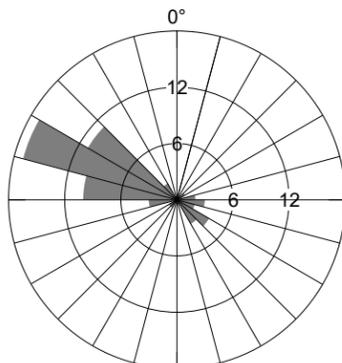
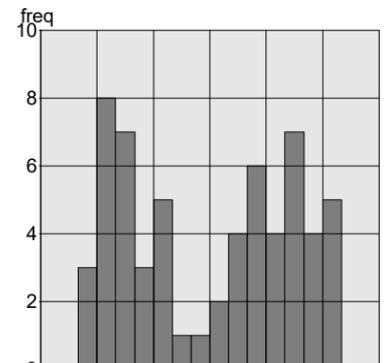
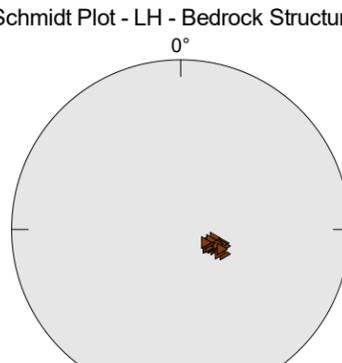
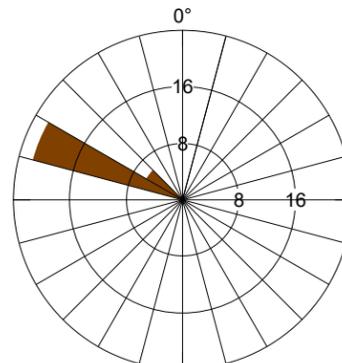
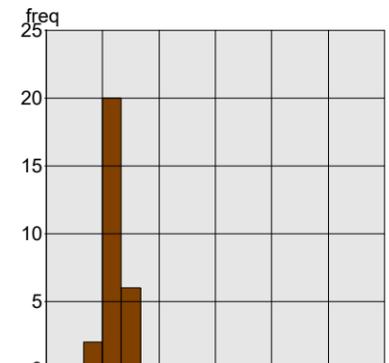
Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
0.9	Ground Surface
6.7	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 96.5	flow up the borehole in the casing at 0.08 gpm under pumping conditions
96.5	Bottom of the 6-Inch Steel Casing
96.5 - 99.2	flow up the borehole in the casing at 0.08 gpm under pumping conditions
99.2 - 109.3	flow into & up the borehole under pumping conditions
109.3 - 126.7	flow up the borehole in the casing at 0.02 gpm under pumping conditions
126.7 - 127.9	minor flow into & up the borehole under pumping conditions
127.9 - 132.7	no flow detected under pumping conditions
132.7	Bottom of the Borehole (based on the geophysical logging)

CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 13° West

STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding

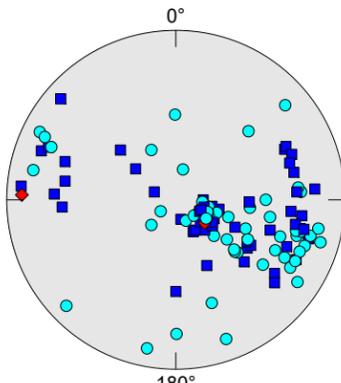
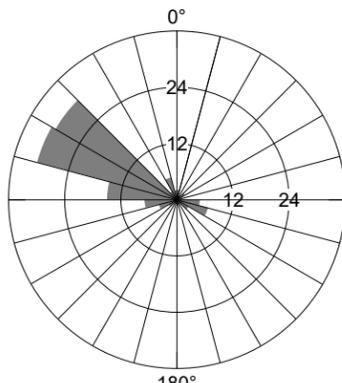
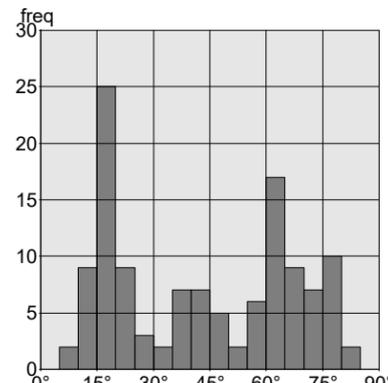
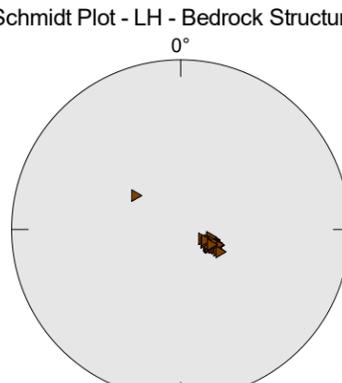
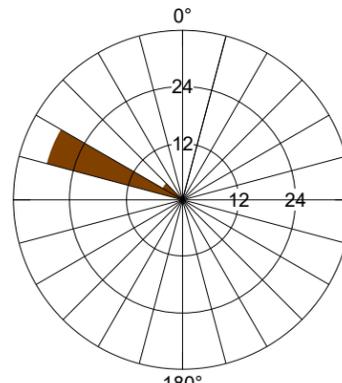
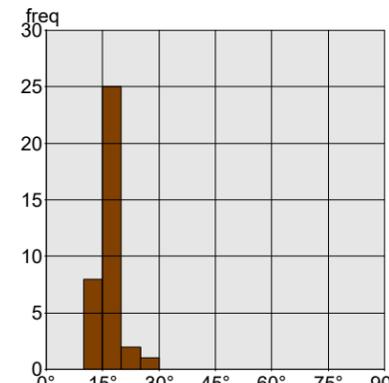
Stereogram - Lower Hemisphere of Fractures	Dip Azimuth Rose Diagram of Fractures	Dip Angle Histogram of Fractures	Stereogram - Lower Hemisphere of Bedding	Dip Azimuth Rose Diagram of Bedding	Dip Angle Histogram of Bedding																																																																												
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CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 13° West

STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding

Stereogram - Lower Hemisphere of Fractures	Dip Azimuth Rose Diagram of Fractures	Dip Angle Histogram of Fractures	Stereogram - Lower Hemisphere of Bedding	Dip Azimuth Rose Diagram of Bedding	Dip Angle Histogram of Bedding																																																																												
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<b>HAGER-RICHTER GEOSCIENCE</b>	
<b>114-MW73D - TABLE OF BEDROCK STRUCTURES</b>	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	February 5, 2024
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 13° West)
DIP ANGLE	Measured from Horizontal

**114-MW73D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
89.8	97	33	Fracture Rank 2
90.0	95	61	Fracture Rank 2
90.7	148	77	Fracture Rank 3
90.8	53	30	Fracture Rank 1
91.4	116	69	Fracture Rank 2
91.8	87	69	Fracture Rank 2
92.2	119	65	Fracture Rank 2
92.8	140	75	Fracture Rank 3
93.3	142	68	Fracture Rank 3
93.8	121	75	Fracture Rank 2
94.0	131	74	Fracture Rank 2
94.1	327	14	Fracture Rank 2
94.4	297	16	Bedding
94.5	131	79	Fracture Rank 1
94.9	319	19	Fracture Rank 2
95.0	296	18	Bedding
95.2	132	72	Fracture Rank 1
95.8	299	24	Bedding
96.2	262	58	Fracture Rank 1
96.8	272	24	Fracture Rank 1
97.0	292	22	Fracture Rank 1
97.2	297	17	Bedding
97.3	92	79	Fracture Rank 1
97.9	288	41	Fracture Rank 1
98.0	292	22	Fracture Rank 2
98.1	283	52	Fracture Rank 2
98.1	291	23	Bedding
98.2	85	62	Fracture Rank 1
98.4	307	27	Fracture Rank 1
98.6	300	19	Bedding
99.3	300	14	Fracture Rank 1
99.4	289	21	Bedding
99.6	290	21	Bedding

**114-MW73D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
99.8	275	56	Fracture Rank 1
100.0	302	22	Bedding
100.2	276	50	Fracture Rank 3
100.3	272	49	Fracture Rank 2
100.7	306	18	Fracture Rank 1
101.0	293	17	Bedding
101.2	295	21	Fracture Rank 2
101.4	303	18	Fracture Rank 2
101.5	297	17	Bedding
101.9	295	19	Bedding
102.4	299	16	Bedding
103.6	239	31	Fracture Rank 1
104.2	288	63	Fracture Rank 2
104.4	282	54	Fracture Rank 2
104.5	302	15	Bedding
104.5	284	55	Fracture Rank 2
104.7	305	16	Bedding
105.0	308	16	Fracture Rank 1
105.0	300	16	Bedding
105.3	296	16	Bedding
105.7	300	17	Bedding
106.0	301	22	Fracture Rank 2
106.1	298	18	Bedding
106.2	302	67	Fracture Rank 1
106.4	300	14	Fracture Rank 1
106.5	296	22	Fracture Rank 1
106.7	301	31	Fracture Rank 1
106.9	296	16	Bedding
107.2	306	50	Fracture Rank 1
107.2	302	16	Fracture Rank 1
107.4	296	24	Fracture Rank 1
107.5	293	18	Fracture Rank 2
107.6	302	16	Bedding
108.6	289	68	Fracture Rank 1
109.5	298	74	Fracture Rank 1
109.9	289	18	Bedding
110.3	217	62	Fracture Rank 1
110.4	285	17	Bedding
110.6	267	31	Fracture Rank 2
110.8	256	37	Fracture Rank 2
111.0	292	19	Bedding
112.0	285	72	Fracture Rank 1
112.3	285	66	Fracture Rank 1
112.4	296	15	Bedding
112.5	289	57	Fracture Rank 1

114-MW73D - TABLE OF BEDROCK STRUCTURES

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
112.7	296	22	Bedding
112.9	283	27	Fracture Rank 2
113.0	287	35	Fracture Rank 2
113.3	280	46	Fracture Rank 1
113.7	293	59	Fracture Rank 1
114.5	290	15	Bedding
114.7	281	18	Fracture Rank 1
114.8	290	17	Fracture Rank 2
115.0	287	55	Fracture Rank 2
115.1	298	14	Bedding

<b>HRGS</b>	
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**114-MW74D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
96.8	276	36	Fracture Rank 1
97.9	95	81	Fracture Rank 2
98.4	179	42	Fracture Rank 1
98.5	227	50	Fracture Rank 1
98.9	46	79	Fracture Rank 1
99.7	109	59	Fracture Rank 2
99.9	308	32	Fracture Rank 1
100.2	11	79	Fracture Rank 1
100.6	110	74	Fracture Rank 2
100.8	311	22	Fracture Rank 2
100.8	113	70	Fracture Rank 2
101.3	93	62	Fracture Rank 2
101.3	304	42	Fracture Rank 2
101.4	100	56	Fracture Rank 2
101.5	301	43	Fracture Rank 2
102.1	111	11	Fracture Rank 2
102.6	127	28	Bedding
102.7	127	25	Fracture Rank 2
103.1	132	36	Fracture Rank 2
103.4	272	36	Fracture Rank 2
103.7	296	69	Fracture Rank 2
103.9	286	71	Fracture Rank 2
104.0	86	57	Fracture Rank 2
104.1	92	80	Fracture Rank 3
104.2	290	70	Fracture Rank 1
104.4	285	72	Fracture Rank 1
105.0	270	44	Fracture Rank 1
105.4	296	21	Fracture Rank 2
105.5	287	17	Bedding
105.8	287	16	Fracture Rank 2
105.9	131	80	Fracture Rank 2
106.0	294	11	Bedding
106.3	269	13	Fracture Rank 2

**114-MW74D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
106.4	304	76	Fracture Rank 1
106.7	154	27	Fracture Rank 1
106.7	194	15	Fracture Rank 1
107.2	296	15	Fracture Rank 1
107.4	298	62	Fracture Rank 1
107.5	285	15	Bedding
107.9	292	37	Fracture Rank 1
108.1	300	41	Fracture Rank 2
108.3	346	10	Fracture Rank 2
108.7	291	19	Bedding
108.7	288	27	Fracture Rank 1
108.8	229	74	Fracture Rank 1
108.8	340	77	Fracture Rank 1
109.0	113	69	Fracture Rank 1
109.2	289	17	Bedding
109.4	340	54	Fracture Rank 1
109.8	300	18	Bedding
110.0	293	17	Fracture Rank 1
110.3	283	22	Fracture Rank 2
110.4	307	17	Fracture Rank 2
110.9	245	60	Fracture Rank 2
111.0	244	62	Fracture Rank 2
111.0	334	35	Fracture Rank 2
111.1	248	63	Fracture Rank 2
111.2	0	45	Fracture Rank 2
111.2	289	16	Bedding
111.3	257	61	Fracture Rank 2
111.5	276	58	Fracture Rank 2
111.7	295	32	Fracture Rank 2
111.8	281	18	Fracture Rank 2
111.8	292	16	Bedding
112.1	292	17	Bedding
112.2	265	71	Fracture Rank 2
112.4	293	16	Bedding
112.4	276	13	Fracture Rank 1
112.5	266	63	Fracture Rank 1
112.5	282	17	Fracture Rank 1
112.7	302	15	Bedding
112.8	301	15	Fracture Rank 1
113.1	294	18	Bedding
113.2	296	18	Fracture Rank 2
113.4	288	21	Fracture Rank 1
113.4	264	62	Fracture Rank 1
113.6	300	19	Fracture Rank 1
113.7	293	20	Bedding

**114-MW74D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
113.9	302	15	Fracture Rank 1
113.9	307	54	Fracture Rank 1
114.1	315	19	Fracture Rank 2
114.3	299	19	Bedding
115.1	293	60	Fracture Rank 2
116.0	290	55	Fracture Rank 1
116.1	295	17	Bedding
116.1	297	56	Fracture Rank 1
116.4	313	19	Fracture Rank 1
116.5	331	18	Fracture Rank 2
116.6	282	75	Fracture Rank 1
116.6	297	18	Bedding
116.7	307	62	Fracture Rank 2
116.9	307	16	Fracture Rank 2
117.0	312	45	Fracture Rank 2
117.1	299	18	Bedding
117.5	102	75	Fracture Rank 1
117.6	299	17	Bedding
117.8	310	65	Fracture Rank 2
117.8	314	26	Fracture Rank 1
118.0	316	21	Fracture Rank 2
118.0	360	68	Fracture Rank 1
118.2	293	19	Bedding
118.4	280	48	Fracture Rank 1
118.4	299	21	Bedding
118.6	310	40	Fracture Rank 1
118.8	305	20	Fracture Rank 1
118.9	252	60	Fracture Rank 2
118.9	300	22	Bedding
119.2	327	18	Fracture Rank 2
119.3	306	22	Fracture Rank 2
119.5	294	17	Fracture Rank 2
120.4	286	78	Fracture Rank 1
121.2	301	68	Fracture Rank 1
121.2	297	17	Bedding
121.6	266	61	Fracture Rank 2
121.8	301	15	Bedding
121.9	303	16	Bedding
122.3	287	64	Fracture Rank 1
122.4	334	11	Fracture Rank 1
122.8	297	17	Bedding
122.9	297	18	Fracture Rank 1
123.8	311	38	Fracture Rank 1
124.3	301	17	Bedding
124.3	301	17	Fracture Rank 2

**114-MW74D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
124.5	301	21	Fracture Rank 2
124.5	116	79	Fracture Rank 1
124.8	297	17	Fracture Rank 2
124.9	286	14	Fracture Rank 2
125.2	292	17	Fracture Rank 1
125.3	302	16	Bedding
125.7	288	49	Fracture Rank 2
126.1	286	15	Bedding
126.3	299	15	Bedding
126.5	298	13	Fracture Rank 1
126.5	293	68	Fracture Rank 1
126.8	311	16	Fracture Rank 2
126.9	308	18	Fracture Rank 3
127.1	284	66	Fracture Rank 1
127.2	292	14	Bedding
127.2	52	9	Fracture Rank 1
127.2	277	64	Fracture Rank 2
127.3	44	17	Fracture Rank 1
127.4	283	65	Fracture Rank 2
127.7	293	16	Bedding
127.9	311	12	Fracture Rank 1
128.0	297	68	Fracture Rank 1
128.2	298	15	Bedding
128.8	285	63	Fracture Rank 1
128.8	299	13	Bedding
128.9	282	61	Fracture Rank 2
128.9	296	13	Fracture Rank 2
129.4	310	38	Fracture Rank 1
129.6	294	13	Bedding
129.6	116	75	Fracture Rank 1
129.9	299	41	Fracture Rank 1
130.0	297	17	Bedding
130.0	292	13	Fracture Rank 2
130.7	283	67	Fracture Rank 2
131.6	302	17	Fracture Rank 1

Schuele, Frederik

---

From: Robert Garfield <rob@hager-richter.com>  
Sent: Sunday, June 30, 2024 12:52 PM  
To: Gleason, Shannon; Schuele, Frederik  
Cc: Mikko Aarnio; Jeff Reid; Nick DeCristofaro  
Subject: RE: PPG - Borehole Geophysical Services at PPG Jersey City, NJ for wells 114-MW73D and 114-MW74D  
Attachments: PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report.pdf; 114-MW74D - Table of Bedrock Structures.xlsx; 114-MW73D - Table of Bedrock Structures.xlsx

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Hi Shannon & Frederik,

I'm sorry this report slipped through the cracks and was so delayed. Attached please find the data report for the borehole geophysical logging conducted by Hager-Richter Geoscience (HRGS) in February 2024 at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey for AECOM.

Borehole Geophysical Logging Scope of Work

Borehole geophysical logging was conducted in two (2) boreholes identified as 114-MW73D and 114-MW74D at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey. The borehole geophysical logging program consisted of the following in each of the logged boreholes. At the time of the borehole geophysical logging field work, each borehole was cased with 6-inch inner diameter steel casing through the overburden and unstable shallow bedrock, and each borehole had 5-inch diameter open bedrock below the casing available for the borehole geophysical logging.

- Optical Televiwer (OTV)
- Acoustic Televiwer (ATV)
- Caliper
- Fluid Temperature
- Fluid Conductivity
- Natural Gamma Ray
- Spontaneous Potential (SP)
- Single Point Resistance (SPR)
- Heat Pulse Flow Meter (HPFM) Under Ambient Conditions
- HPFM Under Stressed (Low Constant Rate Pumping) Conditions

Explanation of the Borehole Geophysical Data Interpretation and Presentation

The datum for depths in this report is the top of the 6-inch steel casing at each borehole. The depths of bedrock structures are reported as the average depths of the top and bottom intersections of the bedrock structures and the

borehole wall. The orientations of bedrock structures are reported as the dip azimuth (dip direction) and dip angle of each structure, as shown in the Televiwer Explanation Figure. The OTV, ATV, and bedrock structure dip azimuth data are referenced to true north using a magnetic declination of 13° west and the bedrock structure dip angle data are reported from horizontal. Please note that the bedrock structure dip azimuth data are perpendicular to strike as used commonly by geologists.

Bedrock structures detected in the televiwer (OTV & ATV) data are grouped into four categories (Fracture Rank 1, Fracture Rank 2, Fracture Rank 3, and Bedding) and are shown as color-coded lines and symbols on the structure projection plots and tadpole plots. The Key to Bedrock Structure Categories figure describes the bedrock structure categories and associated colors and tadpole shapes. The Tadpole Explanation Figure explains how to "read" the tadpole plots. Fracture Rank 1 consists of minor fractures that are not distinct and may not be continuous around the borehole. Fracture Rank 2 consists of intermediate fractures that are distinct and continuous around the borehole with little or no apparent aperture. Fracture Rank 3 consists of major fractures that are distinct and continuous around the borehole with apparent aperture. The Bedding category consists of planar geologic structures in the bedrock interpreted as bedding. The bedding category is only used to characterize bedrock structures in portions of the boreholes in sedimentary bedrock where bedding is detected.

The structure projection plots, sinusoidal curves in the log track labeled Structure Projection, display the depth, orientation, and category of the bedrock structures detected in the televiwer data. Bedrock structures are essentially planar for short distances such as the intersection of the open borehole and the bedrock structure. The intersection of a plane, the bedrock structure, with a cylinder, the borehole, is a circle on the plane. When the circle is unwrapped and plotted as it is in the structure projection plots, the circle plots as a sine wave as shown in the Televiwer Explanation Figure (Figure 3). The structures plotted in the structure projection plots are not corrected for borehole deviation, the structure projection plots represent the apparent orientations (that is, *apparent* dip angles and *apparent* dip azimuths) of the bedrock structures. The correction of the bedrock structure orientations from apparent to true orientations (that is, *true* dip angles and *true* dip azimuths) is then made using the borehole deviation data acquired by the televiwer probes, and these corrected/true orientations are reported in the tadpole plots, bedrock structure statistics plots, and bedrock structure tables.

The data report consists of the following in PDF format.

- o Borehole Geophysical Logging Figures

- Figure 1. Key to bedrock structure categories
- Figure 2. Tadpole plot explanation figure
- Figure 3. Televiwer explanation figure

- o Borehole Geophysical Logs – The borehole geophysical logs are provided at a scale of 1-inch to 2.5-feet, are meant to be printed on 11-inch-wide paper, and consist of the following.

<u>Track #</u>	<u>Log &amp; Description</u>
1.	OTV Image
2.	Depth
3.	ATV Amplitude
4.	ATV Travel Time
	Structure Projection – bedrock structure interpretation plotted in projection view
5.	Acoustic Caliper – borehole diameter in inches
	Tadpole Plot – bedrock structure interpretation plotted as tadpoles
6.	Natural Gamma Ray, SP, & SPR
7.	Depth
8.	Fluid Temperature & Fluid Conductivity
9.	HPFM Under Ambient & Pumping Conditions

## Borehole Flow Interpretation

- Summary of Borehole Flow Tables – The borehole flow tables summarize the borehole flow conditions in each borehole, are meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consist of the following.

<u>Column #</u>	<u>Description</u>
1.	Depth
2.	Comments <ul style="list-style-type: none"><li>○ Borehole Conditions/Construction</li><li>○ Borehole Flow Interpretation</li></ul>

- Bedrock Structure Statistics Plots – The statistics plots consist of all detected bedrock structures in each borehole individually, are meant to be printed on landscape 11-inch x 17-inch paper, and consist of the following.

<u>Track #</u>	<u>Description</u>
1.	Stereogram of Fractures – poles of fractures plotted on an equal area lower hemisphere stereogram
2.	Dip Azimuth Rose Diagram of Fractures
3.	Dip Angle Histogram of Fractures
4.	Stereogram of Foliation & Veins – poles of foliation & veins plotted on an equal area lower hemisphere stereogram
5.	Dip Azimuth Rose Diagram of Foliation & Veins
6.	Dip Angle Histogram of Foliation & Veins

- Tables of Bedrock Structures – The tables of bedrock structures consist of all detected bedrock structures in each borehole individually, are meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consist of the following. In addition to providing the tables of bedrock structures within the data report, these tables are also provided in Microsoft Excel format for your use.

<u>Column #</u>	<u>Description</u>
1.	Depth
2.	Bedrock Structure Dip Azimuth
3.	Bedrock Structure Dip Angle
4.	Bedrock Structure Category

## Borehole Geophysical Logging Results

### Summary of Borehole Flow

The borehole flow interpretation is based primarily on the HPFM data acquired under ambient and pumping conditions along with fluid properties (temperature and conductivity) and the presence of open bedrock fractures and weathering evident in the borehole televiwer (OTV and ATV) data. Vertical flow was not detected in boreholes 114-MW73D and 114-MW74D with the HPFM under ambient conditions. However, flow was detected in both boreholes with the HPFM under stressed (low constant rate pumping) conditions. The HPFM data acquired under stressed conditions were acquired while water was pumped from the boreholes with a pump set near the top of the water column in each borehole. The tables provided below and in the data report summarize the borehole flow condition in each borehole at the time of logging, specifically the approximate depths and rates where flow was detected with the HPFM into and out of the boreholes from hydraulically transmissive bedrock fractures under ambient and pumping conditions.

Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
2.0	Ground Surface
6.5	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 88.6	flow up the borehole in the casing at 0.10 gpm under pumping conditions
88.6	Bottom of the 6-Inch Steel Casing
88.6 - 95.0	flow into & up the borehole under pumping conditions
95.0 - 99.8	flow up the borehole in the casing at 0.03 gpm under pumping conditions
99.8 - 101.5	minor flow into & up the borehole under pumping conditions
101.5 - 115.7	no flow detected under pumping conditions
115.7	Bottom of the Borehole (based on the geophysical logging)

#### 114-MW74D - Summary of Borehole Flow Under Ambient & Pumping Conditions

Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
0.9	Ground Surface
6.7	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 96.5	flow up the borehole in the casing at 0.08 gpm under pumping conditions
96.5	Bottom of the 6-Inch Steel Casing
96.5 - 99.2	flow up the borehole in the casing at 0.08 gpm under pumping conditions
99.2 - 109.3	flow into & up the borehole under pumping conditions
109.3 - 126.7	flow up the borehole in the casing at 0.02 gpm under pumping conditions
126.7 - 127.9	minor flow into & up the borehole under pumping conditions
127.9 - 132.7	no flow detected under pumping conditions
132.7	Bottom of the Borehole (based on the geophysical logging)

#### Summary of Bedrock Structure Statistics

The bedrock structure orientations and statistics are plotted and reported on the bedrock structure statistics plots. Based on the televiewer (OTV & ATV) data from the logged boreholes, the majority of the bedrock fractures detected at the site are approximately parallel to the bedrock bedding in the logged boreholes. The number of bedrock fractures and bedding detected and the most prominent orientations (dip azimuths and dip angles) of these bedrock fractures and bedding are reported in the table below.

#### Summary of Bedrock Structure Statistics for Boreholes 114-MW73D & 114-MW74D

Borehole ID & Date Logged	Structure Type	Number of Structures	Most Prominent Bedrock Structure Dip Azimuths	Most Prominent Bedrock Structure Dip Angles
114-MW73D (February 5, 2024)	Fractures	60	primary: west-northwest (270° - 315°) secondary: east-southeast (75° - 150°)	primary: 10° - 75° from horizontal secondary: 60° - 80° from horizontal
	Bedding	28	northwest (285° - 300°)	15° - 20° from horizontal
114-MW74D (February 5, 2024)	Fractures	122	primary: northwest (285° - 315°) secondary: east-southeast (90° - 120°)	primary: 10° - 80° from horizontal secondary: 55° - 85° from horizontal
	Bedding	36	northwest (285° - 300°)	10° - 20° from horizontal

Should you have any questions or need additional information, feel free to contact us at your convenience.

**BOREHOLE GEOPHYSICAL LOGGING – DATA REPORT**  
**BOREHOLE 114-MW76D**  
**PPG SITE 114 – GARFIELD AVENUE GROUP SITES**  
**JERSEY CITY, NEW JERSEY**

*Prepared for:*

AECOM  
Two City Center, Suite 200  
Portland, Maine 04101

Prepared by:

Hager-Richter Geoscience  
2 Industrial Way S/2  
Atkinson, New Hampshire 03811

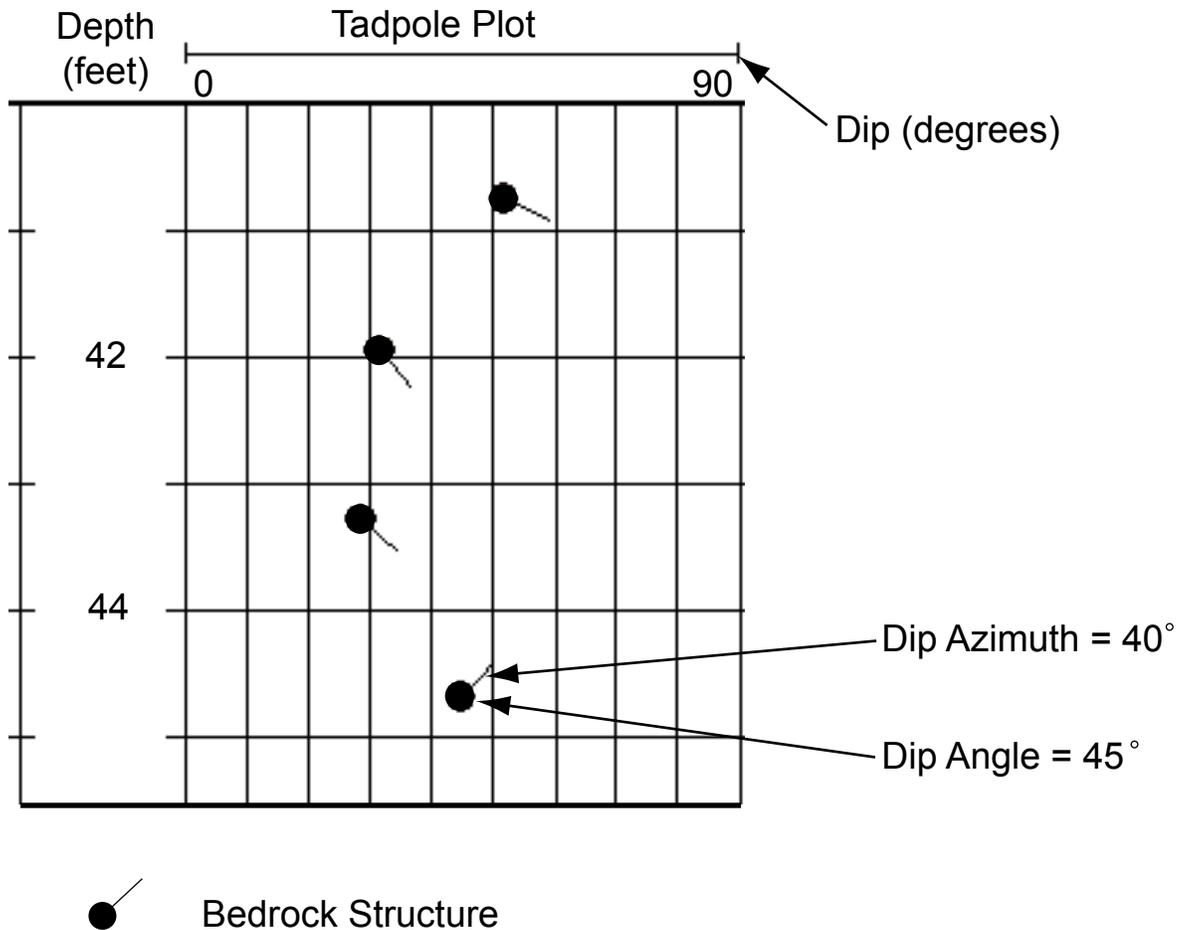
846 Main Street  
Fords, New Jersey 08863

File 19RG66  
August 2024

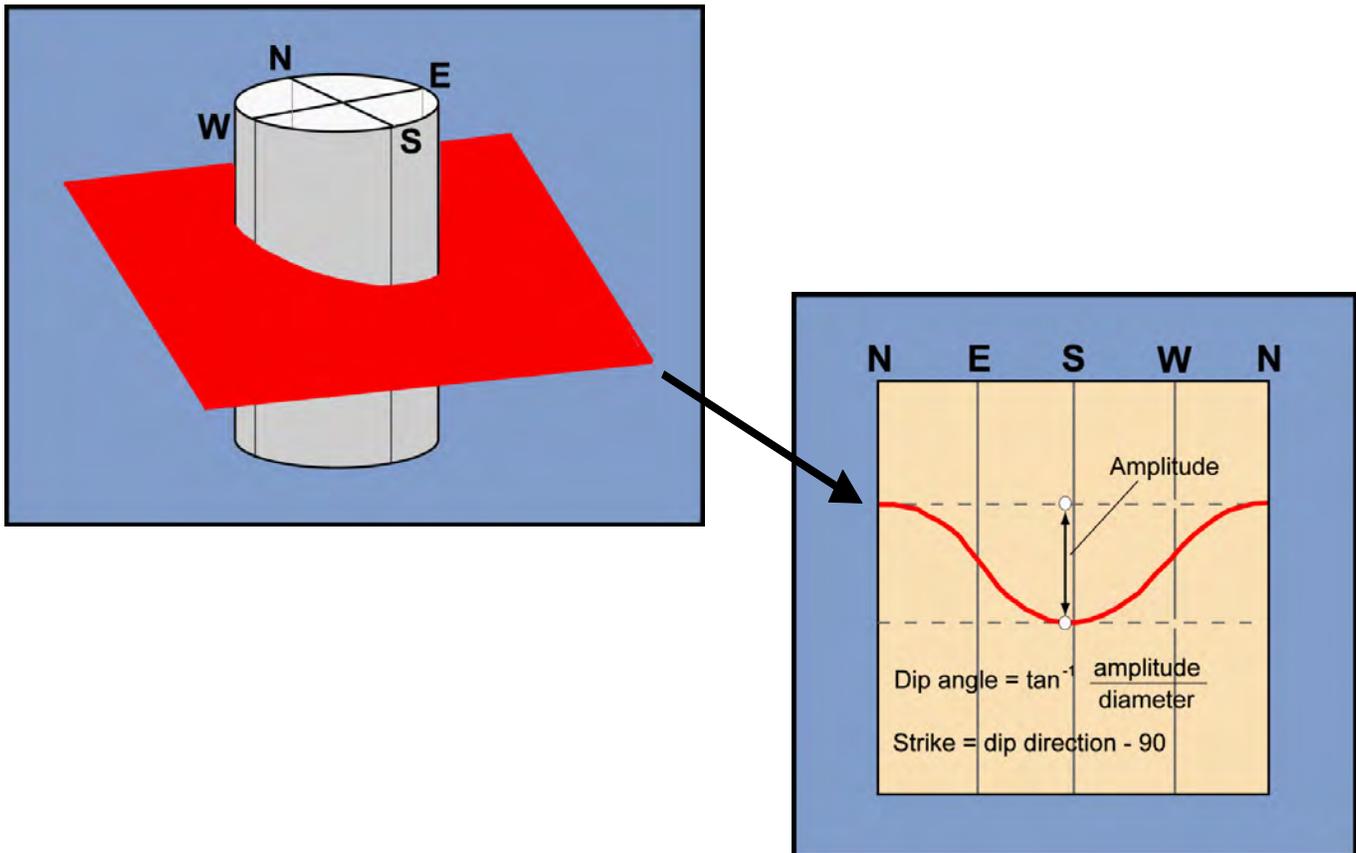
© 2024 Hager-Richter Geoscience, Inc.

Tadpole	Structure Category (Symbol Color)	Description
	Fracture Rank 1 (Light Blue)	Minor Fracture - not distinct and may not be continuous around the borehole
	Fracture Rank 2 (Blue)	Intermediate Fracture - distinct and continuous around the borehole with little or no apparent aperture
	Fracture Rank 3 (Red)	Major Fracture - distinct and continuous around the borehole with apparent aperture

**Figure 1.** Key to bedrock structure categories.



**Figure 2.** Tadpole plot explanation. The orientation of the bedrock structures is graphically displayed by a tadpole consisting of a circle, the head, and a line, the tail. The position of the head, left to right on the tadpole plot, gives the dip angle of the structure. The left side of the track indicates a dip angle of  $0^\circ$ , and the right side of the track indicates a dip angle of  $90^\circ$  from horizontal. The orientation of the tail gives the dip azimuth of the structure and can be read like a compass. The tail pointing directly up is  $0^\circ$ , north.



**Figure 3.** Televiewer explanation. The image on the left depicts a planar structure in red, such as a fracture or bedding plane, intersected by a borehole. The image on the right depicts the same structure unwrapped as it would be displayed in an optical televiewer (OTV) or acoustic televiewer (ATV) log.

Figure modified from: Garfield, R.L., Day-Lewis, F.D., Gray, M.B., Johnson, C.D., Williams, J.H. and Day-Lewis, A.D.F., 2003, Fractured-Rock Aquifer Characterization within a Regional Geologic Context: Results from the Bucknell University Hydrogeophysics Test Site, GSA Northeastern Section, 38th Annual Meeting, Paper No. 25-19.



# HRGS

## HAGER-RICHTER GEOSCIENCE

### 114-MW76D - Summary of Borehole Flow Under Ambient & Pumping Conditions

CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	July 2, 2024
LOG DATUM	Top of the 6-Inch Steel Casing

### 114-MW76D - Summary of Borehole Flow Under Ambient & Pumping Conditions

Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
3.0	Ground Surface
8.4	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 101.6	flow up the borehole in the casing at 0.20 gpm under pumping conditions
101.6	Bottom of the 6-Inch Steel Casing
101.6 - 102.2	flow into & up the borehole under pumping conditions
102.2 - 118.5	flow up the borehole in the casing at 0.02 gpm under pumping conditions
118.5 - 119.4	minor flow into & up the borehole under pumping conditions
119.4 - 125.9	no flow detected under pumping conditions
125.9	Bottom of the Borehole (based on the geophysical logging)

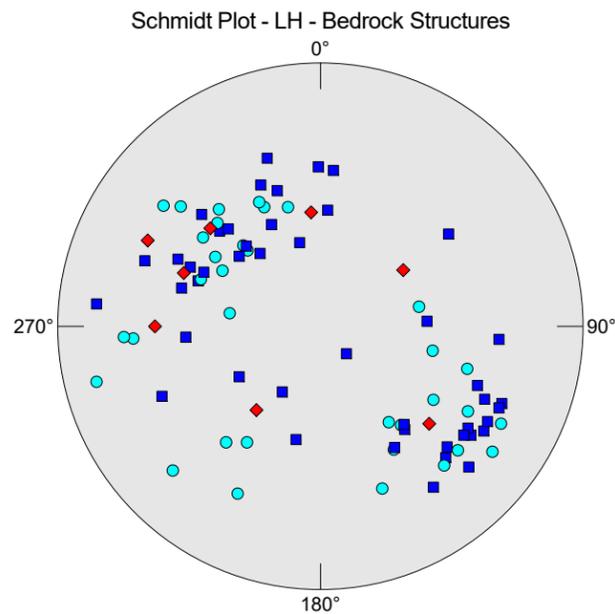
CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 13° West

**STRUCTURE LEGEND**

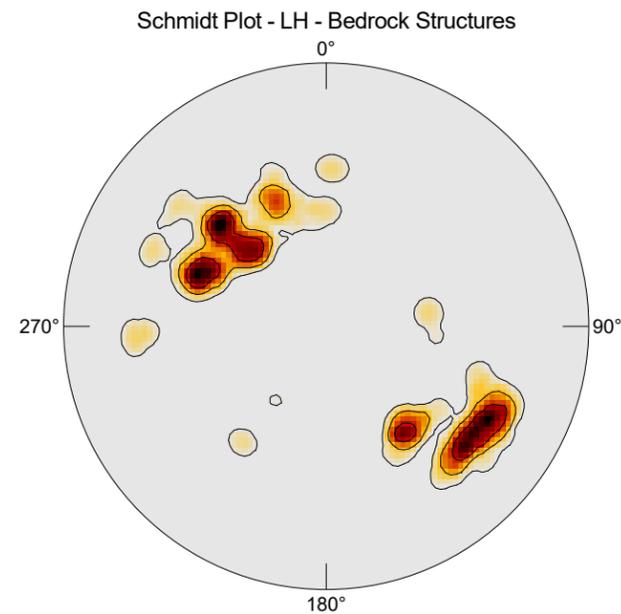
● Fracture Rank 1    ◆ Fracture Rank 2    ■ Fracture Rank 3

Stereogram - Lower Hemisphere  
of Bedrock Fractures



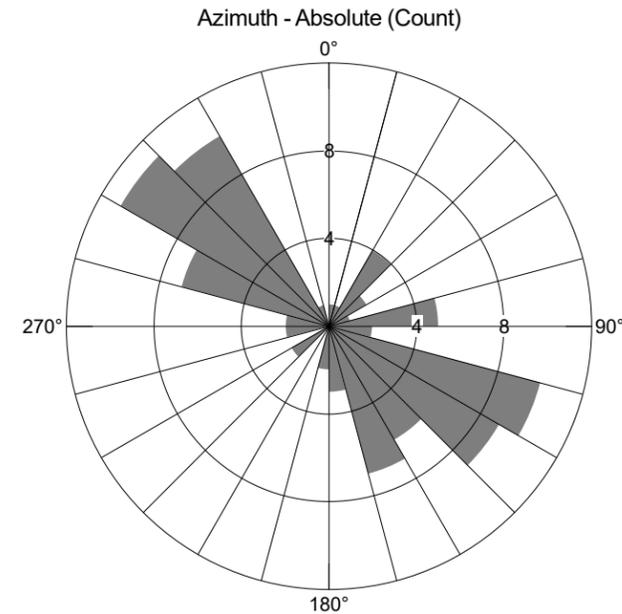
	Counts	Dip[deg]	Azi[deg]
Mean	88	48.09	100.42
■	46	47.91	181.55
◆	8	44.47	120.17
●	34	49.20	72.46

Contoured Stereogram - Lower Hemisphere  
of Bedrock Fractures



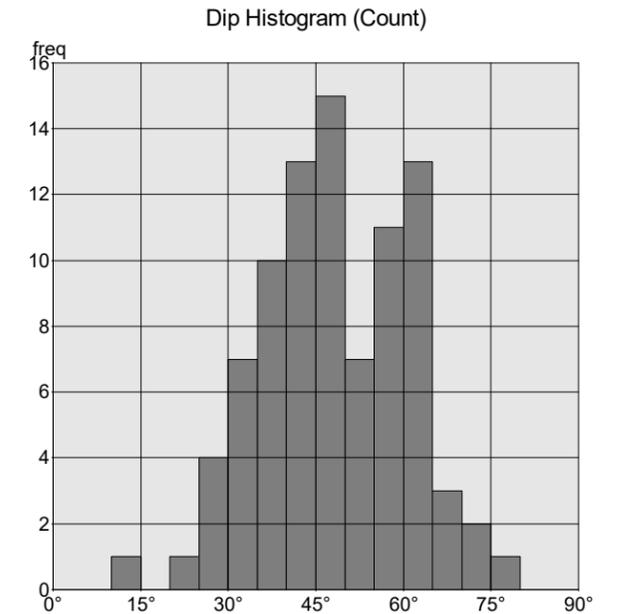
	Counts	Dip[deg]	Azi[deg]
Mean	88	48.09	100.42
■	46	47.91	181.55
◆	8	44.47	120.17
●	34	49.20	72.46

Dip Azimuth Rose Diagram  
of Bedrock Fractures



Components:	Azimuth
Counts:	88.00
Mean (2D):	100.42
Std.Dev.:	125.03
Min:	12.43
Max:	339.00

Dip Angle Histogram  
of Bedrock Fractures



Counts:	88.00
Mean (2D):	48.09
Std.Dev.:	12.58
Min:	11.75
Max:	77.02

<b>HRGS</b>	
<b>HAGER-RICHTER GEOSCIENCE</b>	
<b>114-MW76D - TABLE OF BEDROCK STRUCTURES</b>	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	July 2, 2024
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 13° West)
DIP ANGLE	Measured from Horizontal

**114-MW76D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
102.1	66	56	Fracture Rank 2
102.6	184	36	Fracture Rank 2
103.0	175	36	Fracture Rank 3
103.0	76	77	Fracture Rank 1
103.2	234	50	Fracture Rank 2
103.4	32	44	Fracture Rank 1
103.8	12	36	Fracture Rank 2
104.0	38	33	Fracture Rank 3
104.5	58	30	Fracture Rank 2
104.7	140	30	Fracture Rank 2
105.2	110	41	Fracture Rank 2
105.3	115	45	Fracture Rank 2
105.5	111	47	Fracture Rank 3
106.1	105	46	Fracture Rank 2
106.4	98	29	Fracture Rank 1
106.7	127	47	Fracture Rank 1
106.9	155	41	Fracture Rank 1
107.0	133	44	Fracture Rank 2
107.2	312	60	Fracture Rank 1
107.3	154	44	Fracture Rank 1
107.6	133	52	Fracture Rank 2
107.9	157	49	Fracture Rank 2
108.0	294	58	Fracture Rank 2
108.3	162	45	Fracture Rank 2
108.3	316	59	Fracture Rank 2
108.6	325	64	Fracture Rank 2
108.7	135	46	Fracture Rank 1
108.9	313	67	Fracture Rank 2
109.2	318	60	Fracture Rank 1
109.4	312	46	Fracture Rank 3
109.7	236	31	Fracture Rank 3
109.9	314	56	Fracture Rank 2
110.3	185	50	Fracture Rank 2

**114-MW76D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
110.3	86	61	Fracture Rank 1
110.5	293	64	Fracture Rank 2
110.7	90	53	Fracture Rank 3
111.2	85	43	Fracture Rank 2
111.3	96	75	Fracture Rank 2
111.7	116	63	Fracture Rank 3
112.0	115	50	Fracture Rank 2
112.4	339	56	Fracture Rank 1
112.7	324	37	Fracture Rank 1
112.8	39	48	Fracture Rank 1
112.9	329	45	Fracture Rank 1
113.2	46	68	Fracture Rank 1
113.3	286	49	Fracture Rank 1
113.6	295	64	Fracture Rank 2
114.0	26	60	Fracture Rank 1
114.1	303	63	Fracture Rank 2
114.8	321	40	Fracture Rank 1
114.8	298	67	Fracture Rank 1
115.0	131	59	Fracture Rank 1
115.0	306	60	Fracture Rank 2
115.4	305	58	Fracture Rank 2
115.8	291	54	Fracture Rank 2
116.0	300	55	Fracture Rank 1
116.2	307	58	Fracture Rank 2
116.3	111	61	Fracture Rank 2
116.6	274	58	Fracture Rank 2
116.8	300	63	Fracture Rank 2
116.9	87	64	Fracture Rank 1
117.0	132	47	Fracture Rank 3
117.4	120	36	Fracture Rank 1
117.5	306	70	Fracture Rank 1
117.6	112	41	Fracture Rank 1
117.8	115	40	Fracture Rank 2
118.1	123	40	Fracture Rank 1
118.4	136	35	Fracture Rank 1
118.6	165	39	Fracture Rank 1
118.8	179	51	Fracture Rank 2
119.2	162	57	Fracture Rank 2
119.7	139	49	Fracture Rank 1
120.2	136	42	Fracture Rank 2
120.4	136	33	Fracture Rank 1
120.7	267	33	Fracture Rank 2
120.8	258	31	Fracture Rank 1
121.0	137	34	Fracture Rank 2
121.1	283	36	Fracture Rank 1

114-MW76D - TABLE OF BEDROCK STRUCTURES

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
121.3	154	36	Fracture Rank 2
121.7	166	27	Fracture Rank 2
122.0	131	34	Fracture Rank 2
122.5	128	65	Fracture Rank 1
122.8	30	24	Fracture Rank 2
122.9	303	43	Fracture Rank 1
123.2	317	12	Fracture Rank 2
123.2	329	45	Fracture Rank 2
123.3	321	42	Fracture Rank 2
123.5	319	41	Fracture Rank 2

Schuele, Frederik

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From: Nick DeCristofaro <nick@hager-richter.com>  
Sent: Monday, August 12, 2024 10:18 PM  
To: Schuele, Frederik; Gleason, Shannon  
Cc: Mikko Aarnio; Robert Garfield; Jeff Reid  
Subject: PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report for 114-MW76D  
Attachments: PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report.pdf; 114-MW76D - Table of Bedrock Structures.xlsx

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Hi Frederik & Shannon,

Attached please find the data report for the borehole geophysical logging conducted by Hager-Richter Geoscience (HRGS) in July 2024 at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey for AECOM.

Borehole Geophysical Logging Scope of Work

Borehole geophysical logging was conducted in a borehole identified as 114-MW76D at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey. The borehole geophysical logging program consisted of the following in the logged borehole. At the time of the borehole geophysical logging field work, the borehole was cased with 6-inch steel casing through the overburden and unstable shallow bedrock, and the borehole had approximately 5-inch diameter open bedrock below the casing available for the borehole geophysical logging.

- Optical Televiwer (OTV)
- Acoustic Televiwer (ATV)
- Caliper
- Fluid Temperature
- Fluid Conductivity
- Natural Gamma Ray
- Spontaneous Potential (SP)
- Single Point Resistance (SPR)
- Heat Pulse Flow Meter (HPFM) Under Ambient Conditions
- HPFM Under Stressed (Low Constant Rate Pumping) Conditions

Explanation of the Borehole Geophysical Data Interpretation and Presentation

The datum for depths in this report is the top of the 6-inch steel casing at the borehole. The depths of bedrock structures are reported as the average depths of the top and bottom intersections of the bedrock structures and the borehole wall. The orientations of bedrock structures are reported as the dip azimuth (dip direction) and dip angle of each structure, as shown in the Televiwer Explanation Figure. The OTV, ATV, and bedrock structure dip azimuth data

are referenced to true north using a magnetic declination of 13° west and the bedrock structure dip angle data are reported from horizontal. Please note that the bedrock structure dip azimuth data are perpendicular to strike as used commonly by geologists.

Bedrock structures detected in the televiewer (OTV & ATV) data are grouped into the categories (Fracture Rank 1, Fracture Rank 2, and Fracture Rank 3) and are shown as color-coded lines and symbols on the structure projection plots and tadpole plots. The Key to Bedrock Structure Categories figure describes the bedrock structure categories and associated colors and tadpole shapes. The Tadpole Explanation Figure explains how to "read" the tadpole plots. Fracture Rank 1 consists of minor fractures that are not distinct and may not be continuous around the borehole. Fracture Rank 2 consists of intermediate fractures that are distinct and continuous around the borehole with little or no apparent aperture. Fracture Rank 3 consists of major fractures that are distinct and continuous around the borehole with apparent aperture.

The structure projection plots, sinusoidal curves in the log track labeled Structure Projection, display the depth, orientation, and category of the bedrock structures detected in the televiewer data. Bedrock structures are essentially planar for short distances such as the intersection of the open borehole and the bedrock structure. The intersection of a plane, the bedrock structure, with a cylinder, the borehole, is a circle on the plane. When the circle is unwrapped and plotted as it is in the structure projection plots, the circle plots as a sine wave as shown in the Televiewer Explanation Figure (Figure 3). The structures plotted in the structure projection plots are not corrected for borehole deviation, the structure projection plots represent the apparent orientations (that is, *apparent* dip angles and *apparent* dip azimuths) of the bedrock structures. The correction of the bedrock structure orientations from apparent to true orientations (that is, *true* dip angles and *true* dip azimuths) is then made using the borehole deviation data acquired by the televiewer probes, and these corrected/true orientations are reported in the tadpole plots, bedrock structure statistics plots, and bedrock structure tables.

The data report consists of the following in PDF format.

- Borehole Geophysical Logging Figures

  - Figure 1. Key to bedrock structure categories

  - Figure 2. Tadpole plot explanation figure

  - Figure 3. Televiewer explanation figure

- Borehole Geophysical Logs – The borehole geophysical logs are provided at a scale of 1-inch to 2.5-feet, are meant to be printed on 11-inch-wide paper, and consist of the following.

<u>Track #</u>	<u>Log &amp; Description</u>
1.	OTV Image
2.	Depth
3.	ATV Amplitude
4.	ATV Travel Time
	Structure Projection – bedrock structure interpretation plotted in projection view
5.	Acoustic Caliper – borehole diameter in inches
	Tadpole Plot – bedrock structure interpretation plotted as tadpoles
6.	Natural Gamma Ray, SP, & SPR
7.	Depth
8.	Fluid Temperature & Fluid Conductivity
9.	HPFM Under Ambient & Pumping Conditions
	Borehole Flow Interpretation

- Summary of Borehole Flow Table – The borehole flow table summarizes the borehole flow conditions in the borehole, is meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consists of the following.

Column #   Description

- 1. Depth
- 2. Comments
  - o Borehole Conditions/Construction
  - o Borehole Flow Interpretation

- o Bedrock Structure Statistics Plots – The statistics plots consist of all detected bedrock structures in the borehole, are meant to be printed on landscape 11-inch x 17-inch paper, and consist of the following.

Track #   Description

- 1. Stereogram of Fractures – poles of fractures plotted on an equal area lower hemisphere stereogram
- 2. Contoured Stereogram of Fractures – contours of poles of fractures plotted on an equal area lower hemisphere stereogram
- 3. Dip Azimuth Rose Diagram of Fractures
- 4. Dip Angle Histogram of Fractures

- o Table of Bedrock Structures – The table of bedrock structures consists of all detected bedrock structures in the borehole, is meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consists of the following. In addition to providing the table of bedrock structures within the data report, the table is also provided in Microsoft Excel format for your use.

Column #   Description

- 1. Depth
- 2. Bedrock Structure Dip Azimuth
- 3. Bedrock Structure Dip Angle
- 4. Bedrock Structure Category

### Borehole Geophysical Logging Results

#### Summary of Borehole Flow

The borehole flow interpretation is based primarily on the HPFM data acquired under ambient and pumping conditions along with fluid properties (temperature and conductivity) and the presence of open bedrock fractures and weathering evident in the borehole televiewer (OTV and ATV) data. Vertical flow was not detected in borehole 114-MW76 with the HPFM under ambient conditions. However, flow was detected in the borehole with the HPFM under stressed (low constant rate pumping) conditions. The HPFM data acquired under stressed conditions were acquired while water was pumped from the borehole with a pump set near the top of the water column in the borehole. The table provided below and in the data report summarizes the borehole flow condition in the borehole at the time of logging, specifically the approximate depths and rates where flow was detected with the HPFM into and out of the borehole from hydraulically transmissive bedrock fractures under ambient and pumping conditions.

114-MW76D - Summary of Borehole Flow Under Ambient & Pumping Conditions

Depth (Feet)	Comments
0.0	(flow was not detected in the borehole under ambient conditions) Top of the 6-Inch Steel Casing
3.0	Ground Surface
8.4	Ambient Water Level
15.0 - 16.0	Location of Pump for HPFM Under Pumping Conditions
16.0 - 101.6	flow up the borehole in the casing at 0.20 gpm under pumping conditions
101.6	Bottom of the 6-Inch Steel Casing

101.6 - 102.2	flow into & up the borehole under pumping conditions
102.2 - 118.5	flow up the borehole in the casing at 0.02 gpm under pumping conditions
118.5 - 119.4	minor flow into & up the borehole under pumping conditions
119.4 - 125.9	no flow detected under pumping conditions
125.9	Bottom of the Borehole (based on the geophysical logging)

### Summary of Bedrock Structure Statistics

The bedrock fracture orientations and statistics are plotted and reported on the bedrock fracture statistics plots. Based on the televiewer (OTV & ATV) data from the logged borehole, 88 bedrock fractures were detected. Of the 88 detected bedrock fractures, 34 are interpreted as Fracture Rank 1 (minor) fractures, 46 are interpreted as Fracture Rank 2 (intermediate) fractures, and 8 are interpreted as Fracture Rank 3 (major) fractures. The number of bedrock fractures detected in each logged borehole and the most prominent orientations (dip azimuths and dip angles) of these bedrock fractures are reported in the table below.

### Summary of Bedrock Fracture Statistics

Borehole ID	Number of Structures	Most Prominent Bedrock Fracture Dip Azimuths	Most Prominent Bedrock Fracture Dip Angles
114-MW76D (July 2, 2024)	88	<i>northwest set: northwest (285° - 330°)</i> <i>southeast set: southeast (105° - 165°)</i>	<i>northwest set: primary: 40° - 65° from</i> <i>southeast set: 35° - 50° from ho</i>

Should you have any questions or need additional information, feel free to contact us at your convenience.

Thanks,  
Nick

NICHOLAS DECRISTOFARO  
Borehole Geophysicist

## HRGS

*Geophysics for the Engineering & Environmental Communities*  
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Mobile: 732.547.1636

nick@hager-richter.com | www.hager-richter.com

**BOREHOLE GEOPHYSICAL LOGGING – DATA  
REPORT BOREHOLE 114-MW81D  
PPG SITE 114 – GARFIELD AVENUE GROUP SITES  
JERSEY CITY, NEW JERSEY**

*Prepared for:*

AECOM  
Two City Center, Suite 200  
Portland, Maine 04101

Prepared by:

Hager-Richter Geoscience  
2 Industrial Way S/2  
Atkinson, New Hampshire 03811

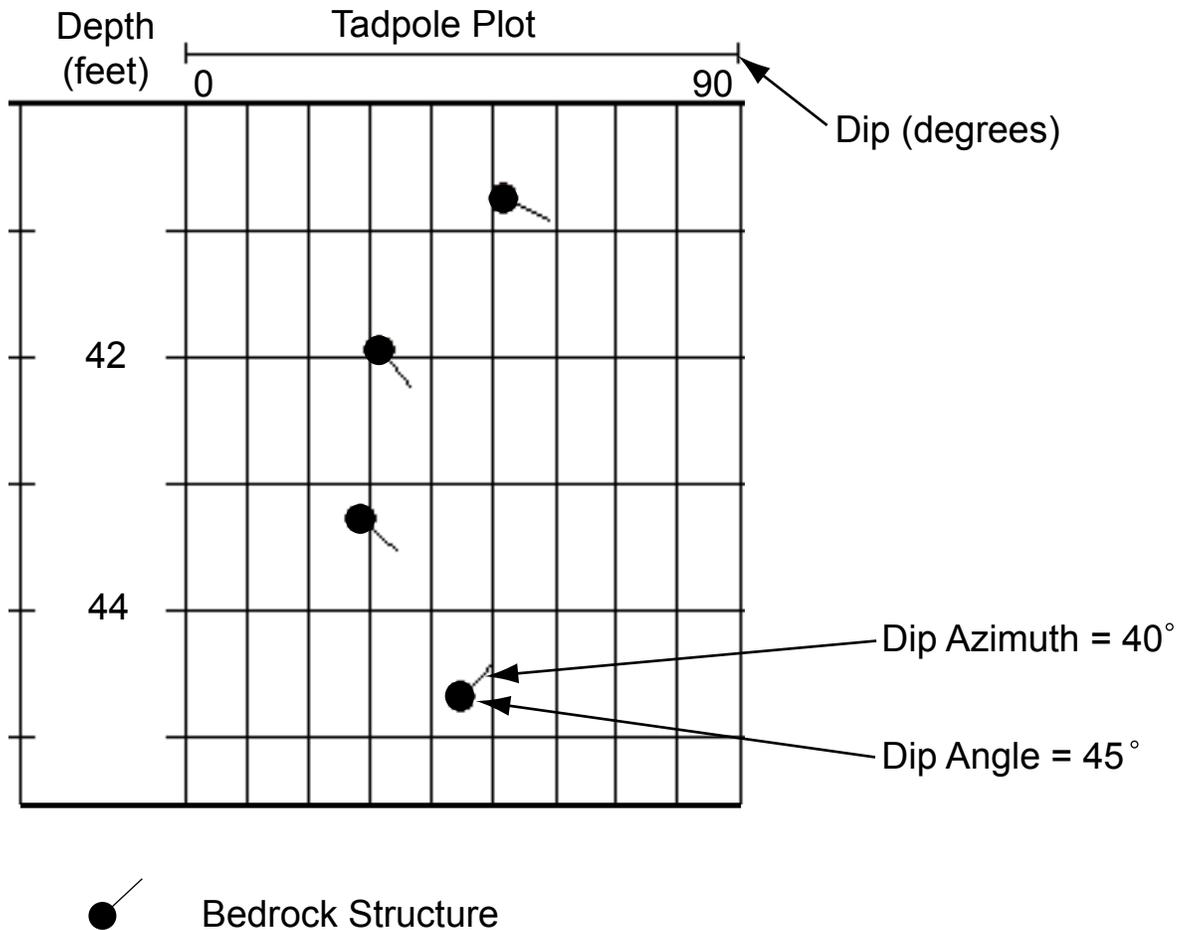
846 Main Street  
Fords, New Jersey 08863

File 19RG66  
December 2024

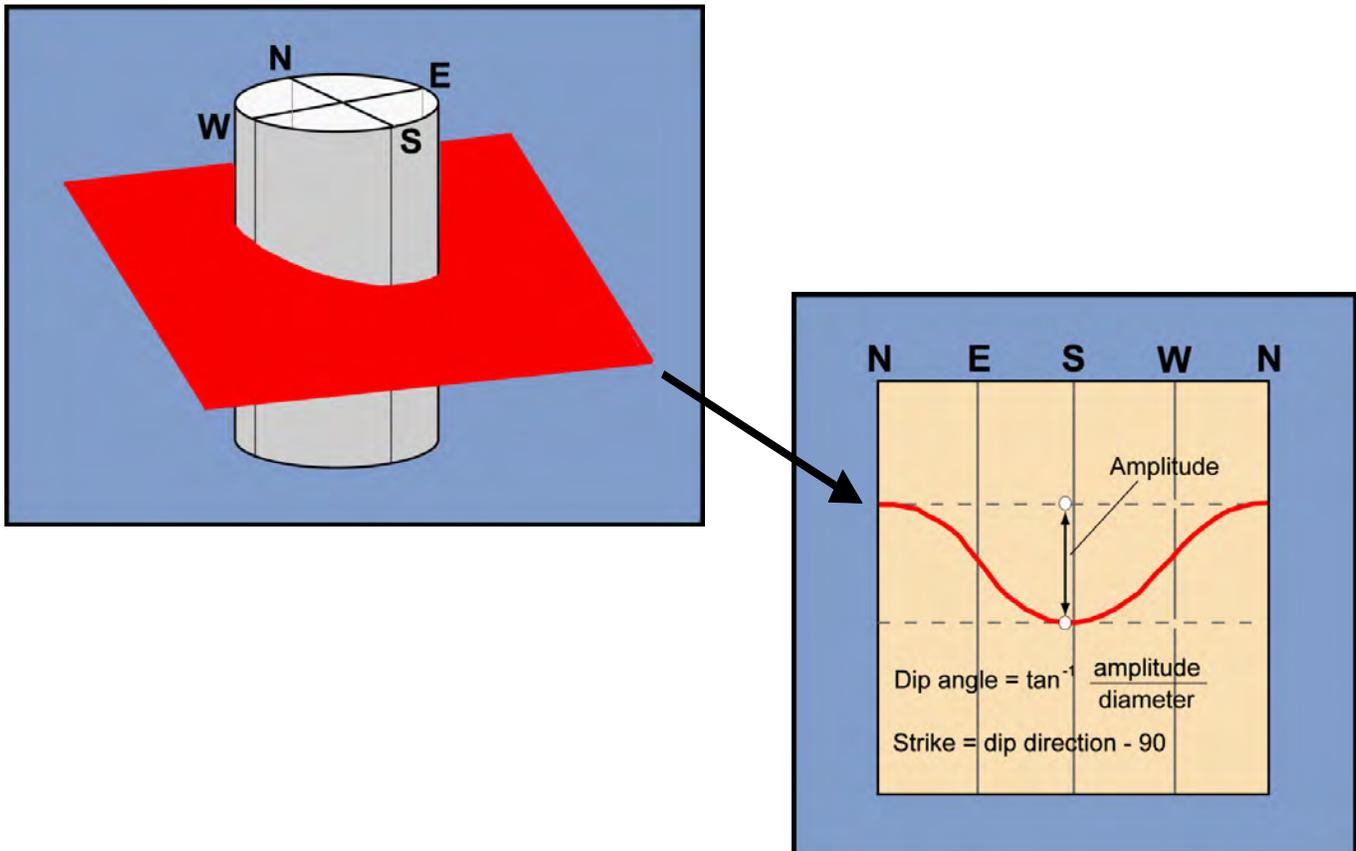
© 2024 Hager-Richter Geoscience, Inc.

Tadpole	Structure Category (Symbol Color)	Description
	Fracture Rank 1 (Light Blue)	Minor Fracture - not distinct and may not be continuous around the borehole
	Fracture Rank 2 (Blue)	Intermediate Fracture - distinct and continuous around the borehole with little or no apparent aperture
	Fracture Rank 3 (Red)	Major Fracture - distinct and continuous around the borehole with apparent aperture

**Figure 1.** Key to bedrock structure categories.



**Figure 2.** Tadpole plot explanation. The orientation of the bedrock structures is graphically displayed by a tadpole consisting of a circle, the head, and a line, the tail. The position of the head, left to right on the tadpole plot, gives the dip angle of the structure. The left side of the track indicates a dip angle of  $0^\circ$ , and the right side of the track indicates a dip angle of  $90^\circ$  from horizontal. The orientation of the tail gives the dip azimuth of the structure and can be read like a compass. The tail pointing directly up is  $0^\circ$ , north.



**Figure 3.** Televiewer explanation. The image on the left depicts a planar structure in red, such as a fracture or bedding plane, intersected by a borehole. The image on the right depicts the same structure unwrapped as it would be displayed in an optical televiewer (OTV) or acoustic televiewer (ATV) log.

Figure modified from: Garfield, R.L., Day-Lewis, F.D., Gray, M.B., Johnson, C.D., Williams, J.H. and Day-Lewis, A.D.F., 2003, Fractured-Rock Aquifer Characterization within a Regional Geologic Context: Results from the Bucknell University Hydrogeophysics Test Site, GSA Northeastern Section, 38th Annual Meeting, Paper No. 25-19.

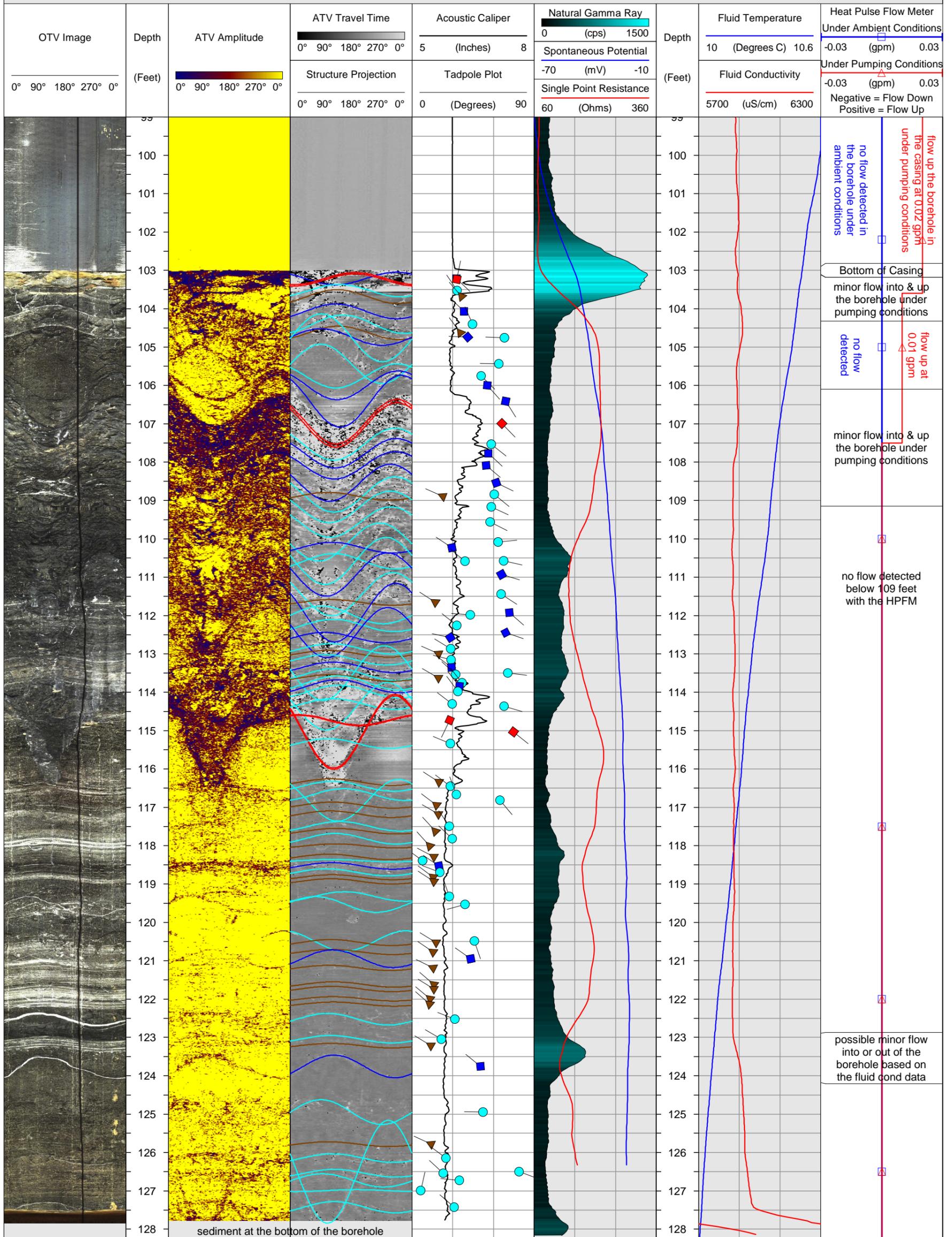
CLIENT: AECOM  
 PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
 LOCATION: Jersey City, New Jersey  
 LOGGING GEOPHYSICIST(S): Mikko Aarnio  
 PROJECT REP(S) ON-SITE: Megan Clark  
 LOGS PROCESSED BY: Robert Garfield, P.G. & Nick DeCristofaro

HRGS FILE: 19RG66  
 LOG DATUM: Top of the 6-Inch Steel Casing  
 TOP OF CASING: 3.2 Feet Above the Ground Surface  
 ORIENTATION REFERENCE: True North (Magnetic Declination = 13° West)  
 BOREHOLE DIAMETER: 6 Inches  
 WATER LEVEL DEPTH: 8.4 Feet

### STRUCTURE LEGEND

- Fracture Rank 1
- Fracture Rank 2
- ◆ Fracture Rank 3
- ▲ Bedding

### 114-MW81D - Borehole Geophysical Logs



# HRGS

## HAGER-RICHTER GEOSCIENCE

### 114-MW81D - Summary of Borehole Flow Under Ambient & Pumping Conditions

CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	December 12, 2024
LOG DATUM	Top of the 6-Inch Steel Casing

### 114-MW81D - Summary of Borehole Flow Under Ambient & Pumping Conditions

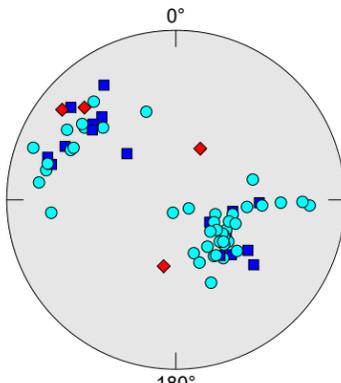
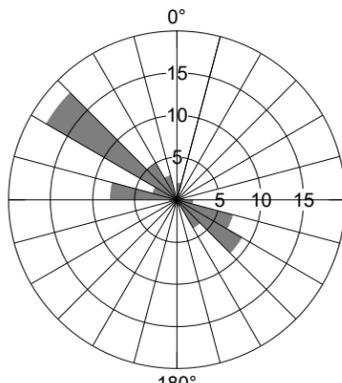
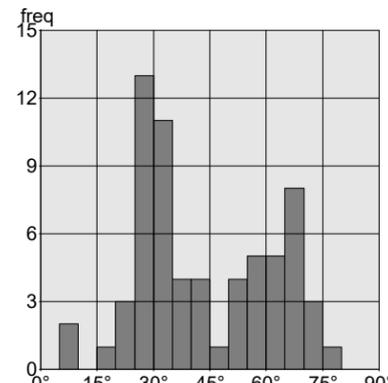
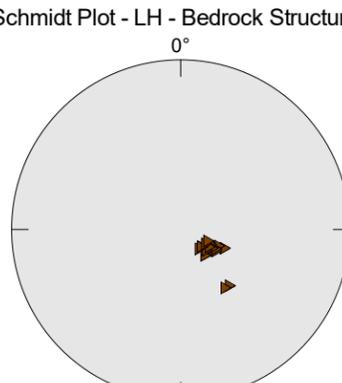
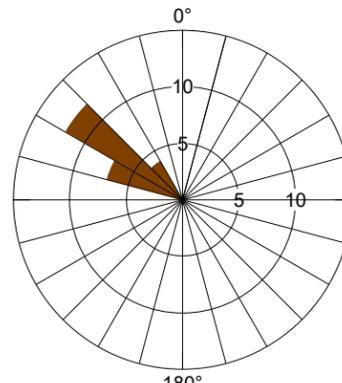
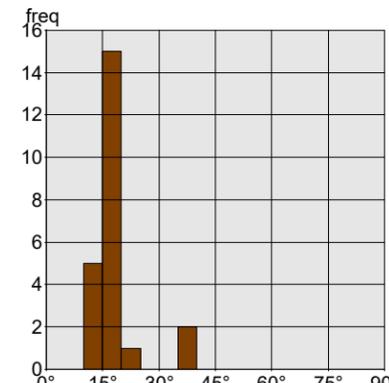
Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
3.2	Ground Surface
8.4	Ambient Water Level
21.0 - 22.0	Location of Pump for HPFM Under Pumping Conditions
22.0 - 103.0	flow up the borehole in the casing at 0.02 gpm under pumping conditions
103.0	Bottom of the 6-Inch Steel Casing
103.0 - 104.3	minor flow into & up the borehole under pumping conditions
104.3 - 106.1	flow up the borehole in the casing at 0.01 gpm under pumping conditions
106.1 - 109.2	minor flow into & up the borehole under pumping conditions
109.2 - 122.9	no flow detected under pumping conditions
122.9 - 124.2	possible minor flow into or out of the borehole based on the fluid cond data
124.2 - 128.3	no flow detected under pumping conditions
128.3	Bottom of the Borehole (based on the geophysical logging)

CLIENT: AECOM  
PROJECT: PPG Site 114 - Garfield Avenue Group Sites  
LOCATION: Jersey City, New Jersey

HRGS FILE: 19RG66  
ORIENTATION REFERENCE: True North  
MAGNETIC DECLINATION: 13° West

STRUCTURE LEGEND

● Fracture Rank 1 ■ Fracture Rank 2 ◆ Fracture Rank 3 ▼ Bedding

Stereogram - Lower Hemisphere of Fractures	Dip Azimuth Rose Diagram of Fractures	Dip Angle Histogram of Fractures	Stereogram - Lower Hemisphere of Bedding	Dip Azimuth Rose Diagram of Bedding	Dip Angle Histogram of Bedding																																																																																				
<p>Schmidt Plot - LH - Bedrock Structures</p>  <table border="1"> <thead> <tr> <th></th> <th>Counts</th> <th>Dip[deg]</th> <th>Azi[deg]</th> </tr> </thead> <tbody> <tr> <td>Mean</td> <td>65</td> <td>43.70</td> <td>306.44</td> </tr> <tr> <td>■</td> <td>18</td> <td>47.25</td> <td>210.24</td> </tr> <tr> <td>◆</td> <td>4</td> <td>50.36</td> <td>135.21</td> </tr> <tr> <td>●</td> <td>43</td> <td>41.59</td> <td>310.14</td> </tr> </tbody> </table>		Counts	Dip[deg]	Azi[deg]	Mean	65	43.70	306.44	■	18	47.25	210.24	◆	4	50.36	135.21	●	43	41.59	310.14	<p>Azimuth - Absolute (Count)</p>  <table border="1"> <thead> <tr> <th>Component</th> <th>Azimuth</th> <th>Counts</th> <th>Mean (2D)</th> <th>Std.Dev.</th> <th>Min</th> <th>Max</th> </tr> </thead> <tbody> <tr> <td>Fractures</td> <td>Azimuth</td> <td>65.00</td> <td>306.44</td> <td>101.99</td> <td>11.01</td> <td>341.46</td> </tr> </tbody> </table>	Component	Azimuth	Counts	Mean (2D)	Std.Dev.	Min	Max	Fractures	Azimuth	65.00	306.44	101.99	11.01	341.46	<p>Dip Histogram (Count)</p>  <table border="1"> <thead> <tr> <th>Statistic</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Counts</td> <td>65.00</td> </tr> <tr> <td>Mean (2D)</td> <td>43.70</td> </tr> <tr> <td>Std.Dev.</td> <td>17.87</td> </tr> <tr> <td>Min</td> <td>6.40</td> </tr> <tr> <td>Max</td> <td>79.06</td> </tr> </tbody> </table>	Statistic	Value	Counts	65.00	Mean (2D)	43.70	Std.Dev.	17.87	Min	6.40	Max	79.06	<p>Schmidt Plot - LH - Bedrock Structures</p>  <table border="1"> <thead> <tr> <th></th> <th>Counts</th> <th>Dip[deg]</th> <th>Azi[deg]</th> </tr> </thead> <tbody> <tr> <td>Mean</td> <td>23</td> <td>18.29</td> <td>304.87</td> </tr> <tr> <td>▼</td> <td>23</td> <td>18.29</td> <td>304.87</td> </tr> </tbody> </table>		Counts	Dip[deg]	Azi[deg]	Mean	23	18.29	304.87	▼	23	18.29	304.87	<p>Azimuth - Absolute (Count)</p>  <table border="1"> <thead> <tr> <th>Component</th> <th>Azimuth</th> <th>Counts</th> <th>Mean (2D)</th> <th>Std.Dev.</th> <th>Min</th> <th>Max</th> </tr> </thead> <tbody> <tr> <td>Bedding</td> <td>Azimuth</td> <td>23.00</td> <td>304.87</td> <td>8.07</td> <td>293.59</td> <td>322.96</td> </tr> </tbody> </table>	Component	Azimuth	Counts	Mean (2D)	Std.Dev.	Min	Max	Bedding	Azimuth	23.00	304.87	8.07	293.59	322.96	<p>Dip Histogram (Count)</p>  <table border="1"> <thead> <tr> <th>Statistic</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Counts</td> <td>23.00</td> </tr> <tr> <td>Mean (2D)</td> <td>18.29</td> </tr> <tr> <td>Std.Dev.</td> <td>5.99</td> </tr> <tr> <td>Min</td> <td>12.93</td> </tr> <tr> <td>Max</td> <td>36.46</td> </tr> </tbody> </table>	Statistic	Value	Counts	23.00	Mean (2D)	18.29	Std.Dev.	5.99	Min	12.93	Max	36.46
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<b>HRGS</b>	
<b>HAGER-RICHTER GEOSCIENCE</b>	
<b>114-MW81D - TABLE OF BEDROCK STRUCTURES</b>	
CLIENT	AECOM
PROJECT	PPG Site 114 - Garfield Avenue Group Sites
LOCATION	Jersey City, New Jersey
HRGS FILE	19RG66
DATE LOGGED	December 12, 2024
LOG DATUM	Top of the 6-Inch Casing
DIP AZIMUTH	True North (Magnetic Declination = 13° West)
DIP ANGLE	Measured from Horizontal

**114-MW81D - TABLE OF BEDROCK STRUCTURES**

Depth (Feet)	Dip Azimuth (Degrees)	Dip Angle (Degrees)	Bedrock Fracture Category
103.2	133	33	Fracture Rank 2
103.2	11	33	Fracture Rank 3
103.5	326	33	Fracture Rank 1
103.7	319	36	Bedding
104.1	315	38	Fracture Rank 2
104.4	337	45	Fracture Rank 1
104.6	323	36	Bedding
104.7	272	41	Fracture Rank 2
104.8	273	68	Fracture Rank 1
105.4	271	64	Fracture Rank 1
105.8	135	51	Fracture Rank 1
106.0	138	55	Fracture Rank 2
106.4	148	69	Fracture Rank 2
107.0	135	66	Fracture Rank 3
107.5	128	58	Fracture Rank 1
107.8	132	56	Fracture Rank 2
108.1	130	54	Fracture Rank 2
108.5	116	62	Fracture Rank 2
108.8	129	61	Fracture Rank 1
108.9	294	23	Bedding
109.2	115	58	Fracture Rank 1
109.6	117	57	Fracture Rank 1
110.1	84	63	Fracture Rank 1
110.2	304	29	Fracture Rank 2
110.6	103	68	Fracture Rank 1
110.6	310	39	Fracture Rank 1
110.9	106	66	Fracture Rank 2
111.4	123	66	Fracture Rank 1
111.7	302	17	Bedding
111.9	131	72	Fracture Rank 2
112.0	274	43	Fracture Rank 1
112.3	308	33	Fracture Rank 1
112.5	108	69	Fracture Rank 2

**114-MW81D - TABLE OF BEDROCK STRUCTURES**

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
112.6	281	28	Fracture Rank 2
112.9	301	29	Fracture Rank 1
113.0	294	20	Bedding
113.2	284	29	Fracture Rank 1
113.4	307	29	Fracture Rank 2
113.5	97	71	Fracture Rank 1
113.5	313	32	Fracture Rank 1
113.6	300	19	Bedding
113.8	321	37	Fracture Rank 1
113.8	322	35	Fracture Rank 2
114.0	324	34	Fracture Rank 1
114.3	307	30	Fracture Rank 1
114.4	106	68	Fracture Rank 1
114.7	206	28	Fracture Rank 3
115.0	129	75	Fracture Rank 3
115.3	292	28	Fracture Rank 1
116.3	302	20	Bedding
116.5	306	28	Fracture Rank 1
116.7	339	33	Fracture Rank 1
116.8	140	65	Fracture Rank 1
117.0	307	18	Bedding
117.2	300	19	Bedding
117.5	326	28	Fracture Rank 1
117.6	317	17	Bedding
117.8	313	30	Fracture Rank 1
118.0	317	13	Bedding
118.3	298	16	Bedding
118.4	305	8	Fracture Rank 1
118.5	304	20	Fracture Rank 2
118.7	291	21	Fracture Rank 1
118.8	307	16	Bedding
118.9	303	16	Bedding
119.3	341	27	Fracture Rank 1
119.5	255	39	Fracture Rank 1
120.5	161	46	Fracture Rank 1
120.5	302	18	Bedding
120.8	304	15	Bedding
121.0	305	43	Fracture Rank 2
121.2	296	15	Bedding
121.6	310	16	Bedding
121.7	302	16	Bedding
122.0	309	13	Bedding
122.1	311	13	Bedding
122.5	292	32	Fracture Rank 1
123.1	301	22	Fracture Rank 1

114-MW81D - TABLE OF BEDROCK STRUCTURES

<b>Depth (Feet)</b>	<b>Dip Azimuth (Degrees)</b>	<b>Dip Angle (Degrees)</b>	<b>Bedrock Fracture Category</b>
123.2	301	14	Bedding
123.8	310	50	Fracture Rank 2
124.9	272	52	Fracture Rank 1
125.8	294	14	Bedding
126.1	307	25	Fracture Rank 1
126.5	110	79	Fracture Rank 1
126.5	313	23	Fracture Rank 1
126.7	276	35	Fracture Rank 1
127.0	13	6	Fracture Rank 1
127.4	311	31	Fracture Rank 1

Schuele, Frederik

---

From: Nick DeCristofaro <nick@hager-richter.com>  
Sent: Sunday, December 29, 2024 5:38 PM  
To: Schuele, Frederik; Gleason, Shannon  
Cc: Mikko Aarnio; Robert Garfield; Jeff Reid  
Subject: PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report for 114-MW81D  
Attachments: PPG Site 114 - GAG Sites - JC, NJ - Borehole Geophysical Logging - Data Report.pdf; 114-MW81D - Table of Bedrock Structures.xlsx

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[Report Suspicious](#)

Hi Frederik,

Attached please find the data report for the borehole geophysical logging conducted by Hager-Richter Geoscience (HRGS) in December 2024 at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey for AECOM.

Borehole Geophysical Logging Scope of Work

Borehole geophysical logging was conducted in a borehole identified as 114-MW81D at the PPG Site 114 – Garfield Avenue Group (GAG) Sites in Jersey City, New Jersey. The borehole geophysical logging program consisted of the following in the logged borehole. At the time of the borehole geophysical logging field work, the borehole was cased with 6-inch steel casing through the overburden and unstable shallow bedrock, and the borehole had approximately 6-inch diameter open bedrock below the casing available for the borehole geophysical logging.

- Optical Televiwer (OTV)
- Acoustic Televiwer (ATV)
- Caliper
- Fluid Temperature
- Fluid Conductivity
- Natural Gamma Ray
- Spontaneous Potential (SP)
- Single Point Resistance (SPR)
- Heat Pulse Flow Meter (HPFM) Under Ambient Conditions
- HPFM Under Stressed (Low Constant Rate Pumping) Conditions

Explanation of the Borehole Geophysical Data Interpretation and Presentation

The datum for depths in this report is the top of the 6-inch steel casing at the borehole. The depths of bedrock structures are reported as the average depths of the top and bottom intersections of the bedrock structures and the borehole wall. The orientations of bedrock structures are reported as the dip azimuth (dip direction) and dip angle of each structure, as shown in the Televiwer Explanation Figure. The OTV, ATV, and bedrock structure dip azimuth data are referenced to true north using a magnetic declination of 13° west and the bedrock structure dip angle data are reported from horizontal. Please note that the bedrock structure dip azimuth data are perpendicular to strike as used commonly by geologists.

Bedrock structures detected in the televiwer (OTV & ATV) data are grouped into four categories (Fracture Rank 1, Fracture Rank 2, Fracture Rank 3, and Bedding) and are shown as color-coded lines and symbols on the structure projection plots and tadpole plots. The Key to Bedrock Structure Categories figure describes the bedrock structure

categories and associated colors and tadpole shapes. The Tadpole Explanation Figure explains how to "read" the tadpole plots. Fracture Rank 1 consists of minor fractures that are not distinct and may not be continuous around the borehole. Fracture Rank 2 consists of intermediate fractures that are distinct and continuous around the borehole with little or no apparent aperture. Fracture Rank 3 consists of major fractures that are distinct and continuous around the borehole with apparent aperture. The Bedding category consists of planar geologic structures in the bedrock interpreted as bedding. The bedding category is only used to characterize bedrock structures in portions of the boreholes in sedimentary bedrock where bedding is detected.

The structure projection plots, sinusoidal curves in the log track labeled Structure Projection, display the depth, orientation, and category of the bedrock structures detected in the televiewer data. Bedrock structures are essentially planar for short distances such as the intersection of the open borehole and the bedrock structure. The intersection of a plane, the bedrock structure, with a cylinder, the borehole, is a circle on the plane. When the circle is unwrapped and plotted as it is in the structure projection plots, the circle plots as a sine wave as shown in the Televiewer Explanation Figure (Figure 3). The structures plotted in the structure projection plots are not corrected for borehole deviation, the structure projection plots represent the apparent orientations (that is, *apparent* dip angles and *apparent* dip azimuths) of the bedrock structures. The correction of the bedrock structure orientations from apparent to true orientations (that is, *true* dip angles and *true* dip azimuths) is then made using the borehole deviation data acquired by the televiewer probes, and these corrected/true orientations are reported in the tadpole plots, bedrock structure statistics plots, and bedrock structure tables.

The data report consists of the following in PDF format.

- o Borehole Geophysical Logging Figures

- Figure 1. Key to bedrock structure categories

- Figure 2. Tadpole plot explanation figure

- Figure 3. Televiewer explanation figure

- o Borehole Geophysical Logs – The borehole geophysical logs are provided at a scale of 1-inch to 2.5-feet, are meant to be printed on 11-inch-wide paper, and consist of the following.

- Track #    Log & Description

- 1.    OTV Image
  - 2.    Depth
  - 3.    ATV Amplitude
  - 4.    ATV Travel Time
  - Structure Projection – bedrock structure interpretation plotted in projection view
  - 5.    Acoustic Caliper – borehole diameter in inches
  - Tadpole Plot – bedrock structure interpretation plotted as tadpoles
  - 6.    Natural Gamma Ray, SP, & SPR
  - 7.    Depth
  - 8.    Fluid Temperature & Fluid Conductivity
  - 9.    HPFM Under Ambient & Pumping Conditions
  - Borehole Flow Interpretation

- o Summary of Borehole Flow Table – The borehole flow table summarizes the borehole flow conditions in the borehole, is meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consists of the following.

- Column #    Description

- 1.    Depth
  - 2.    Comments
    - o    Borehole Conditions/Construction
    - o    Borehole Flow Interpretation

- o Bedrock Structure Statistics Plots – The statistics plots consist of all detected bedrock structures in the borehole, are meant to be printed on landscape 11-inch x 17-inch paper, and consist of the following.

- Track #    Description

- 1.    Stereogram of Fractures – poles of fractures plotted on an equal area lower hemisphere stereogram
  - 2.    Dip Azimuth Rose Diagram of Fractures
  - 3.    Dip Angle Histogram of Fractures

4. Stereogram of Bedding – poles of bedding plotted on an equal area lower hemisphere stereogram
  5. Dip Azimuth Rose Diagram of Bedding
  6. Dip Angle Histogram of Bedding
- o Table of Bedrock Structures – The table of bedrock structures consists of all detected bedrock structures in the borehole, is meant to be printed on standard portrait 8.5-inch x 11-inch paper, and consists of the following. In addition to providing the table of bedrock structures within the data report, the table is also provided in Microsoft Excel format for your use.

Column # Description

1. Depth
2. Bedrock Structure Dip Azimuth
3. Bedrock Structure Dip Angle
4. Bedrock Structure Category

Borehole Geophysical Logging Results

Summary of Borehole Flow

The borehole flow interpretation is based primarily on the HPFM data acquired under ambient and pumping conditions along with fluid properties (temperature and conductivity) and the presence of open bedrock fractures and weathering evident in the borehole televiewer (OTV and ATV) data. Vertical flow was not detected in borehole 114-MW81 with the HPFM under ambient conditions. However, flow was detected in the borehole with the HPFM under stressed (low constant rate pumping) conditions. The HPFM data acquired under stressed conditions were acquired while water was pumped from the borehole with a pump set near the top of the water column in the borehole. The table provided below and in the data report summarizes the borehole flow condition in the borehole at the time of logging, specifically the approximate depths and rates where flow was detected with the HPFM into and out of the borehole from hydraulically transmissive bedrock fractures under ambient and pumping conditions.

114-MW81D - Summary of Borehole Flow Under Ambient & Pumping Conditions

Depth (Feet)	Comments
	(flow was not detected in the borehole under ambient conditions)
0.0	Top of the 6-Inch Steel Casing
3.2	Ground Surface
8.4	Ambient Water Level
21.0 - 22.0	Location of Pump for HPFM Under Pumping Conditions
22.0 - 103.0	flow up the borehole in the casing at 0.02 gpm under pumping conditions
103.0	Bottom of the 6-Inch Steel Casing
103.0 - 104.3	minor flow into & up the borehole under pumping conditions
104.3 - 106.1	flow up the borehole in the casing at 0.01 gpm under pumping conditions
106.1 - 109.2	minor flow into & up the borehole under pumping conditions
109.2 - 122.9	no flow detected under pumping conditions
122.9 - 124.2	possible minor flow into or out of the borehole based on the fluid cond data
124.2 - 128.3	no flow detected under pumping conditions
128.3	Bottom of the Borehole (based on the geophysical logging)

Summary of Bedrock Structure Statistics

The bedrock fracture orientations and statistics are plotted and reported on the bedrock fracture statistics plots. Based on the televiewer (OTV & ATV) data from the logged borehole, 65 bedrock fractures were detected. Of the 65 detected bedrock fractures, 43 are interpreted as Fracture Rank 1 (minor) fractures, 18 are interpreted as Fracture Rank 2 (intermediate) fractures, and only 4 are interpreted as Fracture Rank 3 (major) fractures. The number of bedrock fractures detected in each logged borehole and the most prominent orientations (dip azimuths and dip angles) of these bedrock fractures are reported in the table below.

Summary of Bedrock Fracture Statistics

Borehole ID	Number of Structures	Most Prominent Bedrock Fracture Dip Azimuths	Most Prominent Bedrock Fracture Dip Angles
114-MW81D (December 12, 2024)	65	<i>northwest set:</i> northwest (300° - 315°) <i>southeast set:</i> southeast (105° - 135°)	<i>northwest set:</i> 20° - 45° from horizontal <i>southeast set:</i> 55° - 75° from horizontal

Should you have any questions or need additional information, feel free to contact us at your convenience.

Thanks,

Nick

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