



Celebrating 60 Years
1956-2016

June 21, 2016

Mr. Jason Kerns
HDR
11820 Fountain Way, Suite 204
Newport News, VA 23606

Subject: Project 16C33019.00, Vibration Monitoring Summary Report, Bridge Street Pump Station Project, 515 Bridge Street, Hampton, VA

Dear Mr. Kerns:

SCHNABEL ENGINEERING, LLC (Schnabel) is pleased to present the results of vibration monitoring during construction from May 5 through June 5, 2016. These services are provided in accordance with our subconsultant agreement.

PROJECT DESCRIPTION

This portion of the project consists of the installation of sheet piles for excavation support at 515 Bridge Street. The sheet piles were driven from May 9th to June 1st.

VIBRATION MONITORING

The purpose of the vibration monitoring is to record the vibration levels generated from the sheet pile installation and confirm that the generated vibrations were kept below the project-specified Maximum Allowable Vibration Level [MAVL] of 1.0 inches per second (ips). The equipment was equipped with cellular communications to allow immediate notification if the vibrations did approach the MAVL, to allow a proactive response and limit the disturbance to neighboring properties from excessive vibrations that might damage the adjacent structures, and/or annoy the residents.

Seismic stations were installed on two sides (North and West) of the project on May 5th. A plan showing the seismograph equipment locations is attached (Figure 1). Station 1, on the north side, is located inside the project boundaries, near the townhouses. Station 2, on the west side, is located across Bridge Street from the site, in front of a private residence (47 Marrow Street). That house is approximately 95-feet from the nearest sheet piles.

Table 1 – Seismograph Locations

Station	Location Description	Approx. Distance from Sheet Piles
1	North side, on project site	100 ft.
2	West side, across street from site	50 ft.

HDR
Bridge Street Pump Station

The stations were equipped with a cellular modem for communication with our computer network. The seismographs recorded vibrations in three perpendicular planes of movement: longitudinal, vertical, and transverse. They were set to monitor the vibrations from 5:00 AM to 6:00 PM daily. The seismographs were programmed to "Call Home" to Schnabel's server to download the vibration data at the end of every day and anytime the vibration levels exceeded 1.0-ips. An event report and email notification would be generated if the vibrations exceeded the trigger criteria. The "Call Home" feature allowed automatic notification to anyone on the distribution list that vibration levels exceeding the allowable criterion had been recorded.

CONSTRUCTION MONITORING ANALYSIS

The table below summarizes the daily peak vibration levels. The vibrations never exceeded the MAVL of 1.0-ips during the recording period at either station. The highest recorded peak vibration was 0.76 ips at 21 Hz on May 16th at Station 2. The daily peak vibration levels for each station are summarized below, and plotted on Figures 2 and 3.

Table 2 – Recorded Vibration Data

Date	Daily Peak Vibrations (ips/Hz)		Date	Daily Peak Vibrations (ips/Hz)	
	Station 1	Station 2		Station 1	Station 2
5/06	0.04 / 16	0.03 / 34	5/22	0.02 / >100	0.02 / 64
5/07	0.01 / 14	0.02 / 37	5/23	0.02 / 27	0.02 / 37
5/08	0.01 / 15	0.03 / 51	5/24	0.29 / 20	0.13 / 20
5/09	0.06 / 16	0.03 / 15	5/25	0.11 / 20	0.06 / 17
5/10	0.05 / 16	0.04 / 37	5/26	0.35 / 22	0.08 / 21
5/11	0.13 / 18	0.14 / 19	5/27	0.02 / 22	0.40 / >100
5/12	0.18 / 21	0.26 / 22	5/28	0.01 / 100	0.02 / 57
5/13	0.24 / 64	0.51 / 22	5/29	0.01 / 100	0.01 / >100
5/14	0.01 / >100	0.02 / 47	5/30	0.02 / 20,22	0.02 / 85
5/15	0.01 / >100	0.02 / 51	5/31	NR	0.10 / 20
5/16	0.10 / 20	0.76 / 21	6/01	NR	0.17 / 21
5/17	0.07 / 17	0.24 / 21	6/02	NR	0.20 / 57,73
5/18	0.08 / 16	0.24 / 17	6/03	NR	0.04 / 12
5/19	0.18 / 20	0.68 / 20	6/04	NR	0.02 / 64,73
5/20	0.22 / 22	0.28 / 22	6/05	NR	0.07 / 57
5/21	0.01 / >100	0.02 / 47			

NR = Seismograph did not record. Charging system failed.

CONCLUSIONS

The seismograph records indicate that from May 6 to June 5, 2016, there were no vibrations that exceeded the project-specified Maximum Allowed Vibration Level of 1.0-ips at Stations 1 and 2. It should be noted that vibration levels beyond the monitoring stations will decrease significantly with increased distance from the sheet pile driving.

We have endeavored to provide the professional services as reported herein in accordance with generally accepted geosciences practices, and make no other warranties, either express or implied, as to the services provided under the terms of this agreement and included in this report.

We appreciate the opportunity to be of service. Please feel free to contact us if you have questions concerning this report.

Sincerely,

SCHNABEL ENGINEERING, LLC



Benjamin R. Like, PG
Associate



Gib Seese, PE
Principal

Enclosures:

Figure 1 – Seismograph Location Plan
Figure 2 – Plotted Vibration Data @ Station 1
Figure 3 – Plotted Vibration Data @ Station 2
Event Reports for Stations 1 and 2

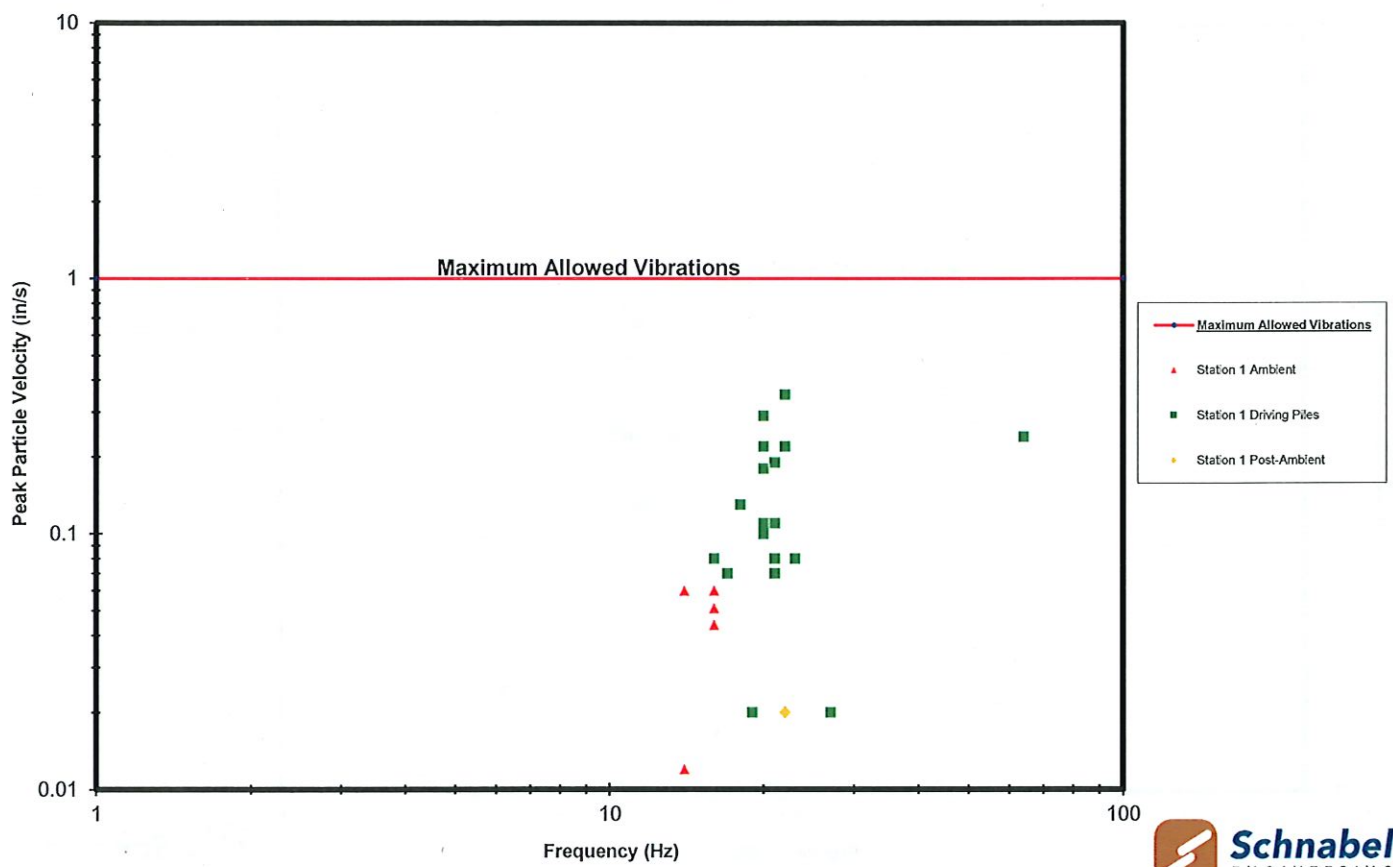


BRIDGE STREET PUMP STATION
HAMPTON, VIRGINIA

Figure Name:	SEISMOGRAPH LOCATION PLAN	Done:	M. SNARR	Figure Number:	1
Project Number:	16C33019.00	Reviewed:	G. SEESE	Date:	JUNE 2016

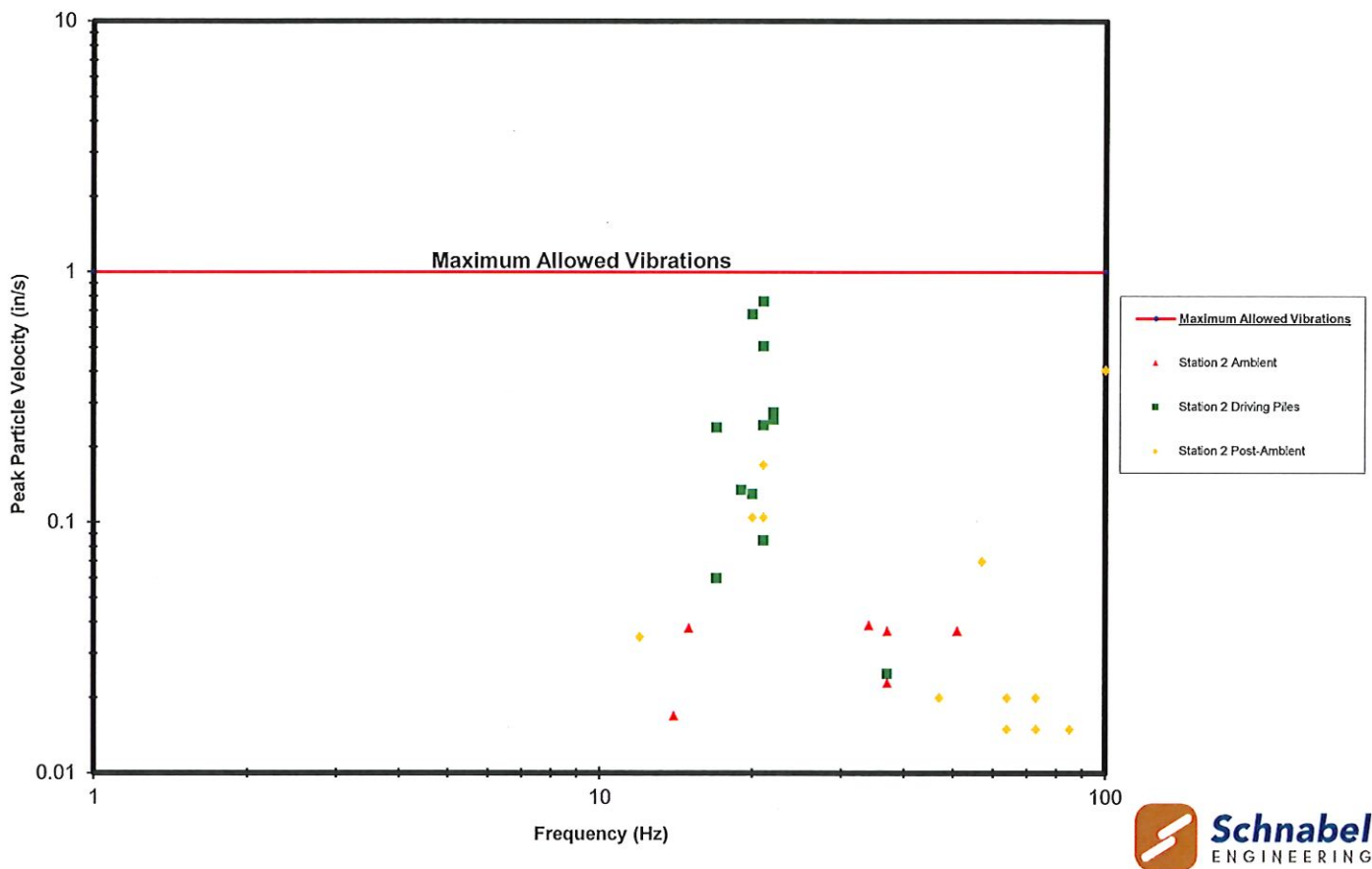
Bridge Street Pump Station
RECORDED VIBRATIONS @ STATION 1

Figure 2



Bridge Street Pump Station
RECORDED VIBRATIONS @ STATION 2

Figure 3



Histogram Start Time 05:00:14 May 6, 2016
Histogram Finish Time 17:59:00 May 6, 2016
Number of Intervals 779.00 at 1 minute
Range Geo:1.250 in/s
Sample Rate 1024sps

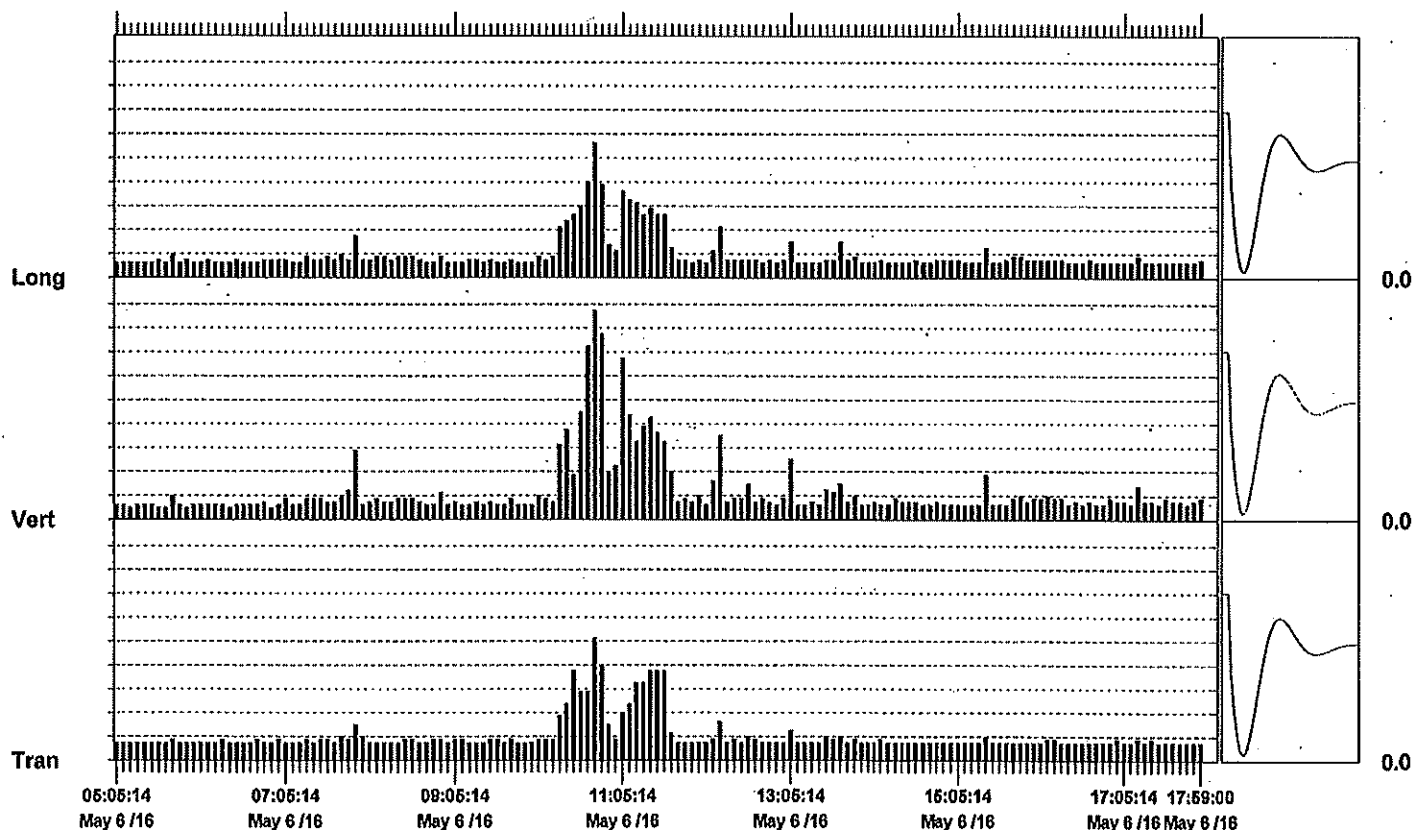
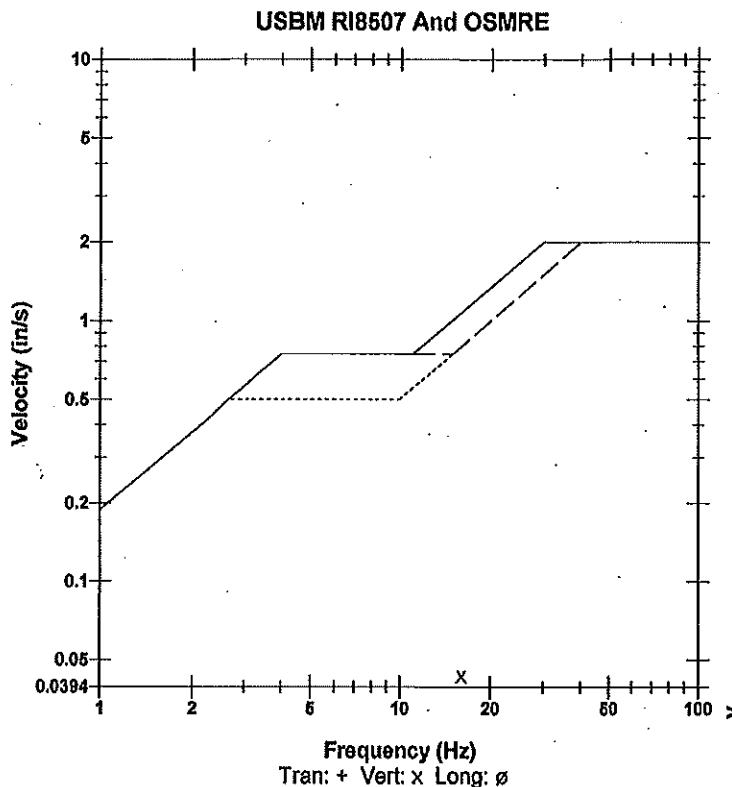
Serial Number BE12062 V 10.72-8.17 MiniMate Plus
Battery Level 6.8 Volts
Unit Calibration February 18, 2016 by Instantel
File Name N062GCWD.WE0H

Notes

Location: Station 1
Client: HDR
User Name: BRL/RR
Project: Bridge Street Pump Station

	Tran	Vert	Long	
PPV	0.026	0.044	0.028	in/s
ZC Freq	11	16	18	Hz
Date	May 6 /16	May 6 /16	May 6 /16	
Time	10:41:14	10:43:14	10:43:14	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.5	Hz
Overswing Ratio	3.9	3.5	3.9	

Peak Vector Sum 0.044 in/s on May 6, 2016 at 10:43:14



Sensor Check

Histogram Start Time 05:00:14 May 7, 2016
Histogram Finish Time 17:59:00 May 7, 2016
Number of Intervals 779.00 at 1 minute
Range Geo: 1.250 in/s
Sample Rate 1024sps

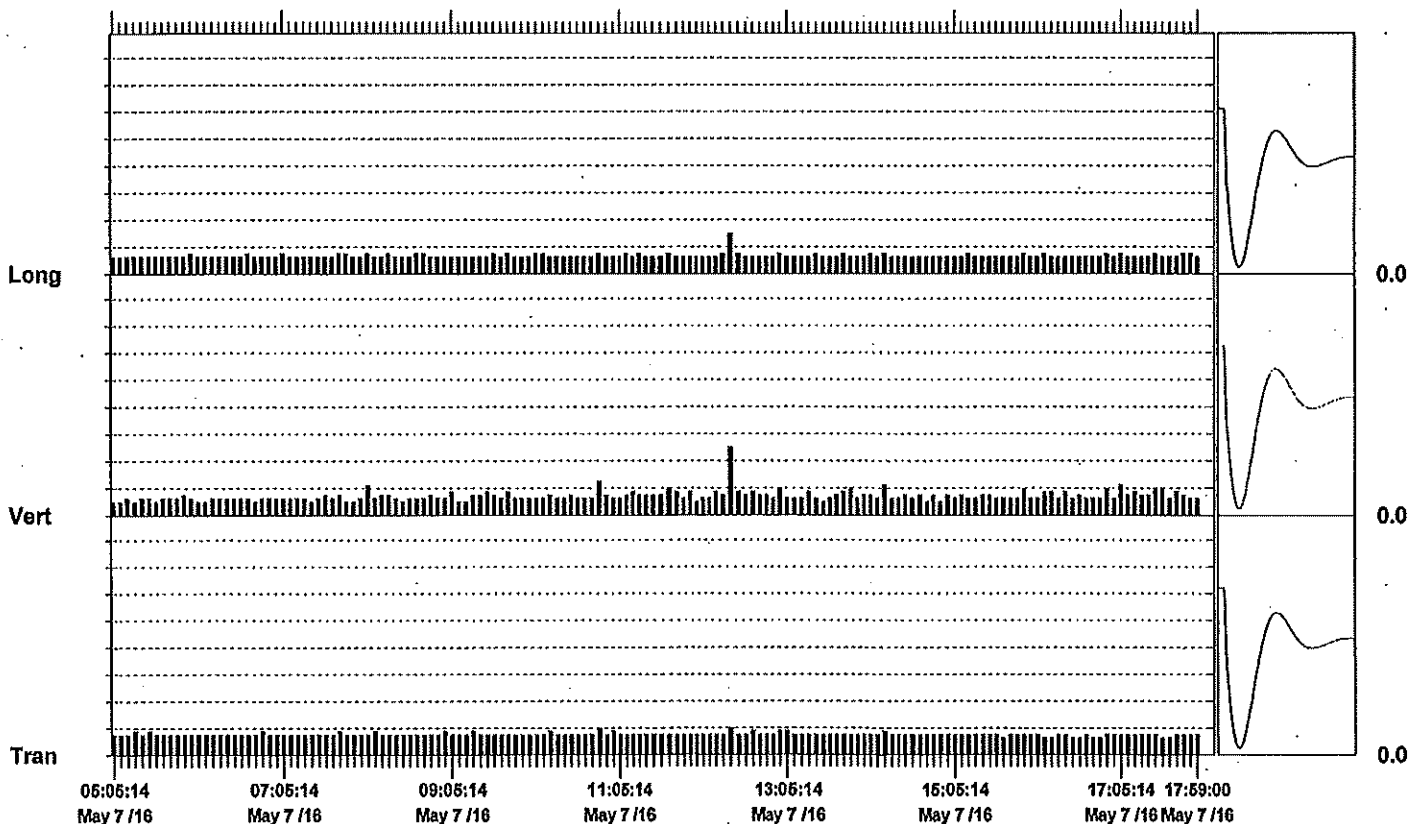
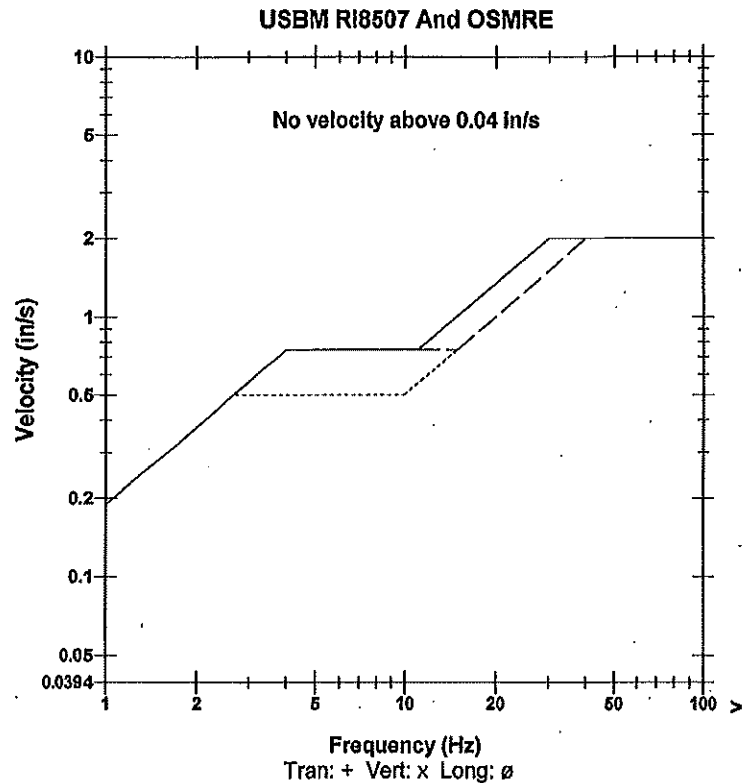
Serial Number BE12062 V 10.72-8.17. MiniMate Plus
Battery Level 6.8 Volts
Unit Calibration February 18, 2016 by Instantel
File Name N062GCY8.KE0H

Notes

Location: Station 1
Client: HDR
User Name: BRL/RR
Project: Bridge Street Pump Station

	Tran	Vert	Long	
PPV	0.005	0.012	0.007	in/s
ZC Freq	12	14	15	Hz
Date	May 7 /16	May 7 /16	May 7 /16	
Time	10:48:14	12:23:14	12:23:14	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.5	Hz
Overswing Ratio	3.9	3.5	3.9	

Peak Vector Sum 0.013 in/s on May 7, 2016 at 12:23:14



Time Scale: 5 minutes /div Amplitude Scale: Geo: 0.005 in/s/div

Sensor Check

Histogram Start Time 05:00:14 May 8, 2016
Histogram Finish Time 17:59:00 May 8, 2016
Number of Intervals 779.00 at 1 minute
Range Geo:1.250 in/s
Sample Rate 1024sps

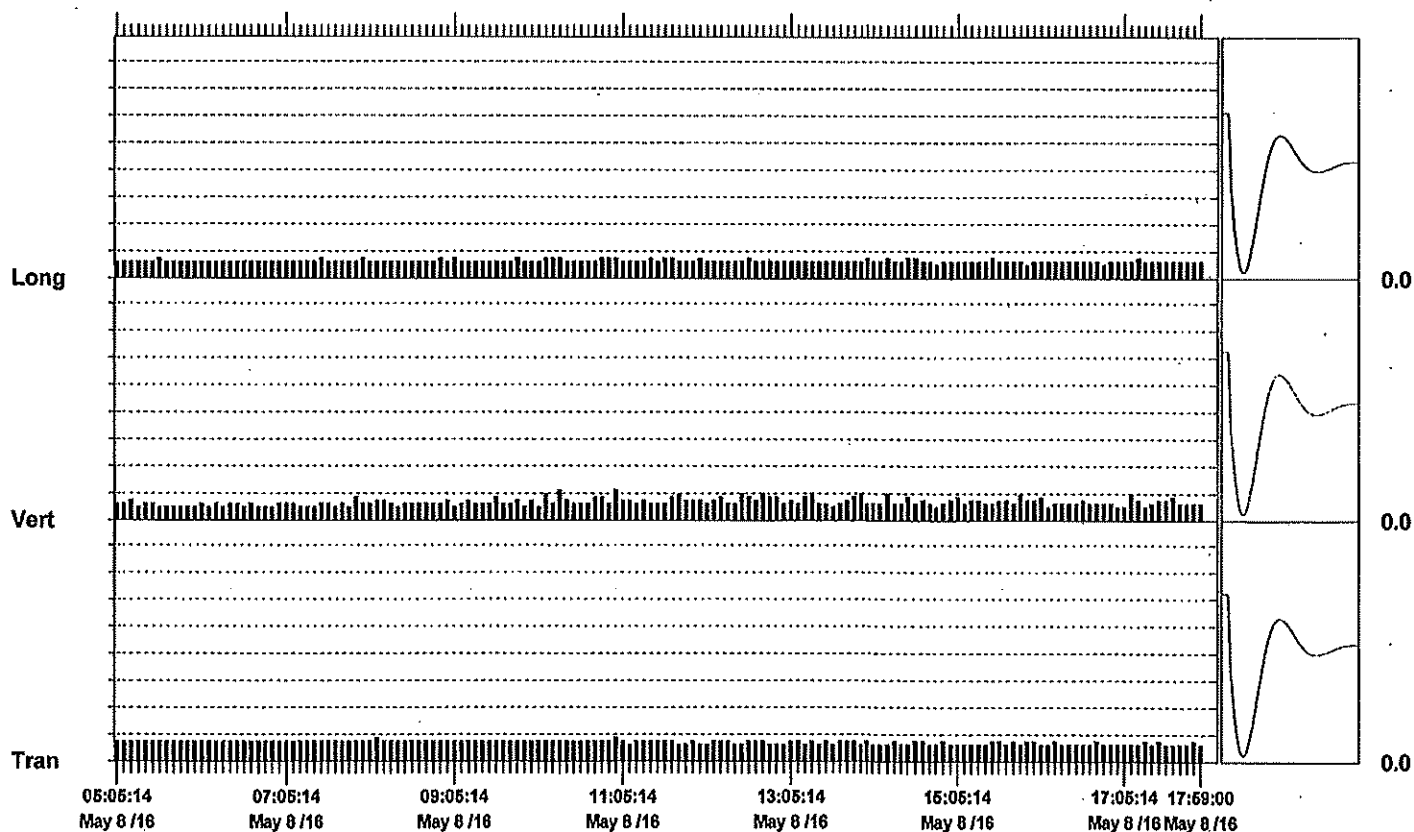
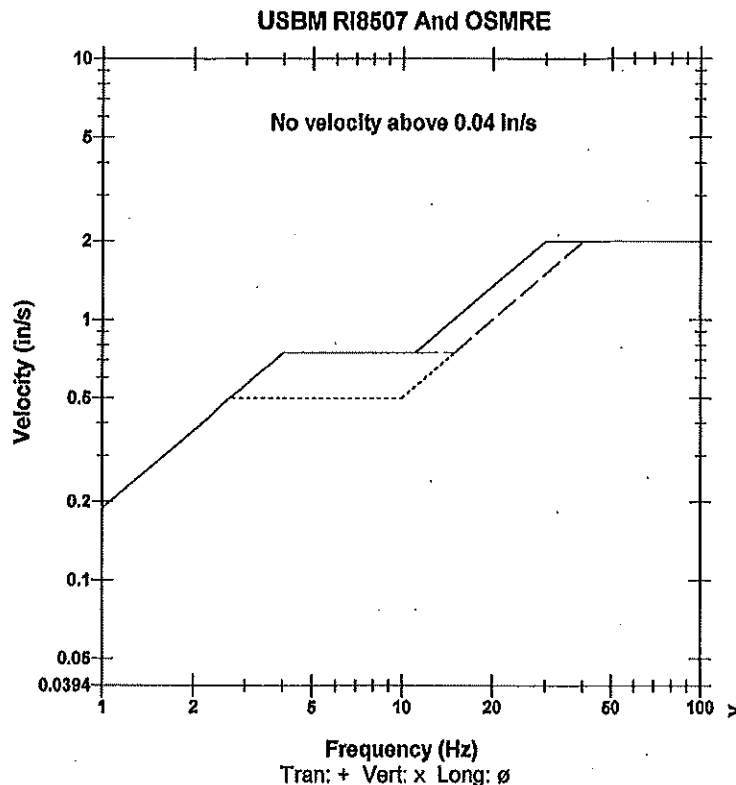
Serial Number BE12062 V 10.72-8.17 MiniMate Plus
Battery Level 6.7 Volts
Unit Calibration February 18, 2016 by Instantel
File Name N062GD03.8EOH

Notes

Location: Station 1
Client: HDR
User Name: BRL/RR
Project: Bridge Street Pump Station

	Tran	Vert	Long	
PPV	0.004	0.006	0.004	in/s
ZC Freq	11	15	73	Hz
Date	May 8 /16	May 8 /16	May 8 /16	
Time	08:08:14	10:19:14	05:32:14	
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.7	7.5	Hz
Overswing Ratio	3.9	3.5	3.8	

Peak Vector Sum 0.007 in/s on May 8, 2016 at 10:19:14



Time Scale: 5 minutes /div **Amplitude Scale:** Geo: 0.005 in/s/div

Sensor Check

Histogram Start Time 05:00:14 May 9, 2016
Histogram Finish Time 17:59:00 May 9, 2016
Number of Intervals 779.00 at 1 minute
Range Geo: 1.250 in/s
Sample Rate 1024sps

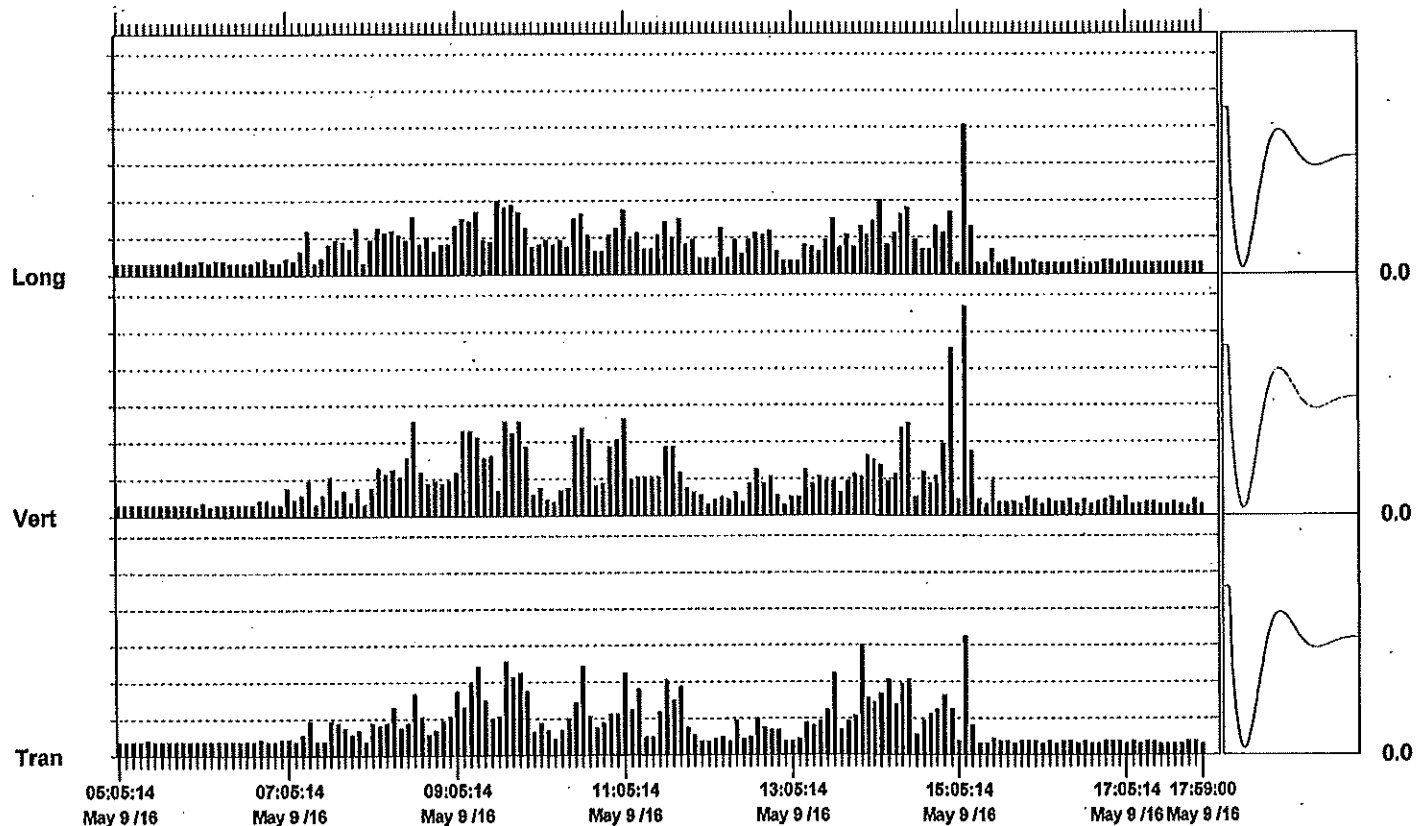
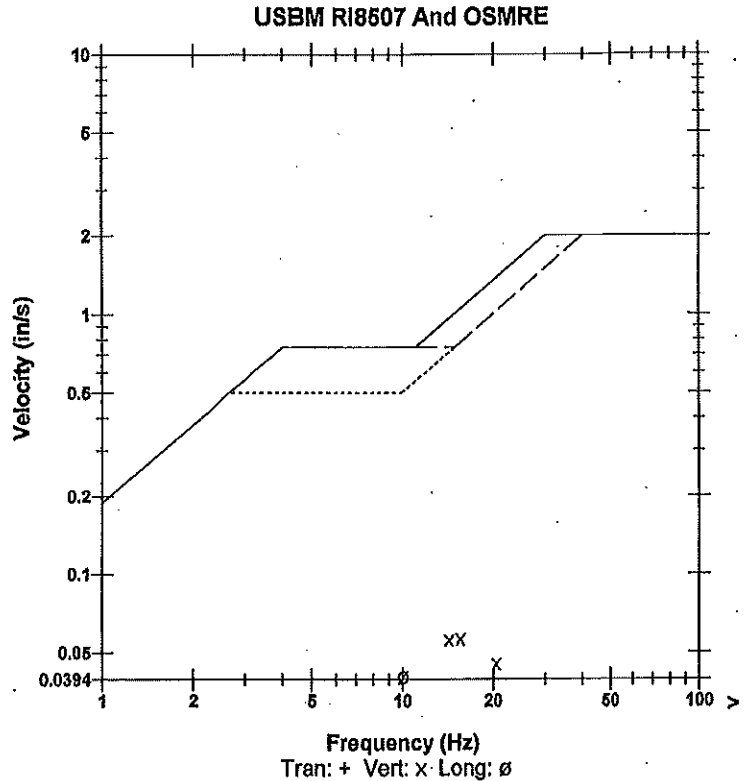
Serial Number BE12062 V 10.72-8.17 MiniMate Plus
Battery Level 6.8 Volts
Unit Calibration February 18, 2016 by Instantel
File Name N062GD1X.WE0H

Notes

Location: Station 1
Client: HDR
User Name: BRL/RR
Project: Bridge Street Pump Station

	Tran	Vert	Long	
PPV	0.032	0.057	0.041	in/s
ZC Freq	15	16	10	Hz
Date	May 9 /16	May 9 /16	May 9 /16	
Time	15:08:14	15:10:14	15:09:14	
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.7	7.5	Hz
Overswing Ratio	3.8	3.5	3.8	

Peak Vector Sum 0.058 in/s on May 9, 2016 at 15:09:14



Sensor Check