



Specialists in Explosives, Blasting and Vibration
Consulting Engineers

June 25, 2018

Dragados-Tomlinson Joint Venture
5597 Power Road
Ottawa, Ontario
K1G 3N4

Attention: Mr. Kevin Stadelmann

Re: Interim Weekly Vibration Monitoring Report – June 18 to June 24, 2018
Combined Sewage Storage Tunnel (CSST) – Site 5 Operations

Dear Mr. Stadelmann,

Attached please find the interim weekly summary report detailing the results of the vibration monitoring program developed and implemented as part of the construction operations for the Combined Sewage Storage Tunnel (CSST) Project – Site 5 Operations in Ottawa, Ontario. This monitoring program was initiated on March 31, 2017 and has been recording vibrations generated as a result of the construction equipment in order to confirm predictable levels and to guard against possible adverse impacts on the surrounding structures.

A full time on-site Vibration Monitoring Program is currently implemented to delineate vibration intensities experienced at a representative sampling of structures around the Site 5 construction areas as a result of the construction equipment in operation. The monitoring instruments installed consist of Instantel tri-directional digital seismographs capable of measuring vibration intensities up to 254mm/s at a frequency response of 2 – 250Hz or 1 – 315Hz depending on the installation. The units are programmed to measure all vibration levels continuously at a sampling rate of 1024 samples per second. Following each five minute interval, the units review the 307,200 measured vibrations and permanently records the peak particle velocity for that time interval while deleting all subordinate vibration intensities. This process is repeated for all subsequent five minute time intervals thereby providing maximum vibration intensities experienced at the monitored areas throughout the day.



Such a configuration permits continuous monitoring of vibration levels and provides complete coverage of all vibrations, construction induced or otherwise, experienced at the monitored structure. Events recorded under this program mode are marked by an “H” on the vibrations summary report. As an additional analytical tool, the seismographs are configured to record a more detailed waveform in the event that vibration intensities exceeded a pre-set trigger of 4mm/s. This feature permits advanced analysis in the event that anomalous elevated readings are recorded. Events recorded under this program mode are marked by a “W” on the vibrations summary report.

As per the Contract Specification 02482, Subsection 1.5.1.1, the following threshold, response and shutdown values are observed at Site 5:

Project Threshold, Response and Shutdown Values			
Description of Event	Threshold Value (PPV)	Response Value (PPV)	Shutdown Value (PPV)
Continuous/ Intermittent Source	4mm/s	6mm/s	7mm/s
Transient Source	5mm/s	8mm/s	9mm/s
Blasting	10mm/s	16mm/s	20mm/s

The monitoring locations itemized below were installed for the following sites on the listed days and remain installed during the construction operations:

Site 5A/5B

- **141/151 Stanley Avenue** – Installed on March 31, 2017
- **IOS Shaft IOS Location** (Borehole and Surface) – Installed on Oct 13, 2017
- **IOS Shaft 5A Location** (Borehole and Surface) – Removed on May 3, 2018



Site 5C

- **54 Queen Victoria Street** – Installed on March 31, 2017
- **51 Queen Victoria Street** – Installed on April 11, 2017
- **55 Queen Victoria Street** – Installed on January 12, 2018
- **50 Queen Victoria Street** – Installed on January 12, 2018

The following readings generated at Site 5 monitoring locations exceeded the 4mm/s trigger level during the interim monitoring period:

Vibration Readings Exceeding 4mm/s During Interim Monitoring Period						
Ref. Event #	Location	Date	Time	Velocity (mm/s)	Cause of Event	Applicable Project Limit Exceeded
Site 5A/5B						
1 to 23	IOS Shaft IOS – Borehole	June 18, 2018	00:26 to 16:19	Up to 22.10	RF / Power Spikes	N/A – Not Construction Related
24 to 29	151 Stanley Avenue	June 18, 2018	9:34 to 9:54	Up to 11.05	RF / Power Spikes	N/A – Not Construction Related
30	141 Stanley Avenue	June 18, 2018	10:05	4.064	RF / Power Spikes	N/A – Not Construction Related
31	IOS Shaft IOS – Borehole	June 24, 2018	18:35	4.826	RF / Power Spikes	N/A – Not Construction Related
No Events						
N/A	No Events	N/A	N/A	N/A	N/A	N/A

EXPLOTECH

All recorded Histogram summaries and Waveform details for Site 5 are available for reference at anytime on the www.constructionvibrations.com website. A summary list is attached to this interim report for reference. Should you have any questions or concerns related to the information contained herein or the monitoring program undertaken, please do not hesitate to contact the undersigned at your leisure.

Kindest regards,



Mitch Malcomson, P.Eng.

**CSST - Site 5
M7550A DTJV
June 18, 2018 to June 24, 2018**

Event Report: Event List - z:\to be archived\2 csst temp folders\site 5

Type	Serial No.	Date/Time	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	PVS1 (mm/s)	Tran2 Peak (mm/s)	Vert2 Peak (mm/s)	Long2 Peak (mm/s)	PVS2 (mm/s)	Mic Peak (dB)	Description
W	BE16212	Jun 18 /18 00:26:08	2.667	4.699	3.683	6.539	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 00:28:24	5.461	10.54	2.540	11.89	0.381	0.381	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 01:36:06	5.461	10.54	0.635	11.89	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 01:38:22	0.889	0.381	6.096	6.103	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 01:38:24	0.889	0.381	6.096	6.103	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 01:40:39	6.477	3.556	3.048	7.883	0.381	0.381	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 02:06:49	6.477	3.302	3.048	7.883	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 02:09:05	2.794	4.191	3.175	4.604	0.381	0.381	0.381	0.458	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 04:02:26	0.508	4.191	1.905	4.604	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 04:05:22	3.175	4.445	2.794	5.462	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 04:24:13	3.175	4.445	0.381	5.462	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 04:26:29	1.651	1.905	4.572	4.863	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 05:11:42	1.651	0.508	4.572	4.863	0.381	0.254	0.254	0.381	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 05:13:57	3.556	2.286	2.413	4.637	0.381	0.254	0.381	0.458	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Jun 18 /18 06:02:34	0.381	0.254	0.254	0.421	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE16212	Jun 18 /18 06:06:43	2.540	1.651	8.890	8.995	0.762	0.381	0.635	0.773	***	Site 5A - IOS Shaft IOS Location
H	BE22085	Jun 18 /18 06:06:51	0.762	1.143	1.016	1.454	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE18786	Jun 18 /18 06:06:52	0.889	1.143	0.762	1.251	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE17376	Jun 18 /18 06:07:35	1.651	1.524	1.397	2.646	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20059	Jun 18 /18 06:07:44	0.762	1.270	0.381	1.276	3.048	0.889	5.080	5.083	98.8L	Site 5AB - 141+151 Stanley Ave
W	BE16212	Jun 18 /18 09:00:59	0.762	1.143	8.890	8.995	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 09:03:18	1.651	5.842	2.794	6.599	0.508	0.254	0.508	0.648	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:12:17	1.270	5.842	2.794	6.599	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 09:14:36	3.556	4.953	9.652	11.42	0.508	0.381	0.635	0.684	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:22:54	3.556	4.953	9.652	11.42	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 09:25:10	5.969	1.270	2.286	6.393	0.508	0.254	0.381	0.554	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:27:15	5.969	1.270	2.286	6.393	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 09:34:35	5.207	6.604	3.556	6.915	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jun 18 /18 09:34:44	0.635	0.508	0.254	0.696	1.016	0.635	5.080	5.083	94.0L	Site 5AB - 141+151 Stanley Ave
W	BE16212	Jun 18 /18 09:35:19	5.207	6.604	2.413	6.915	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 09:37:20	0.762	1.524	0.254	1.529	4.064	1.016	3.302	4.377	91.5L	Site 5AB - 141+151 Stanley Ave
W	BE20059	Jun 18 /18 09:37:29	0.635	1.524	0.254	1.529	4.064	1.016	3.302	4.377	91.5L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:38:15	4.445	9.144	5.334	11.39	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:38:20	4.445	9.144	5.334	11.39	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 09:40:02	0.762	2.032	0.254	2.036	8.763	1.270	11.05	14.10	95.9L	Site 5AB - 141+151 Stanley Ave
W	BE20059	Jun 18 /18 09:40:14	0.635	1.016	0.254	1.024	8.763	1.270	11.05	14.10	95.9L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:40:37	2.032	7.366	11.81	14.07	0.508	0.254	0.254	0.508	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:40:38	2.032	7.366	11.81	14.07	0.508	0.254	0.254	0.508	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 09:42:47	0.762	0.635	0.254	0.783	0.889	1.270	7.239	7.253	94.0L	Site 5AB - 141+151 Stanley Ave
W	BE20059	Jun 18 /18 09:42:48	0.762	0.635	0.254	0.783	0.889	1.270	7.239	7.253	94.0L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:43:41	7.239	3.175	3.429	7.442	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:43:44	7.239	3.175	3.429	7.442	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 09:45:21	2.032	3.048	0.254	3.051	4.191	1.524	4.699	4.716	110.2L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:46:02	22.10	4.699	9.144	23.99	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:46:02	22.10	4.699	9.144	23.99	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jun 18 /18 09:47:13	0.889	3.048	0.254	3.051	4.191	1.524	4.699	4.716	94.0L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:49:02	2.667	5.842	7.620	7.751	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:49:11	1.397	5.842	7.620	7.751	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 09:49:46	1.397	1.143	0.254	1.540	4.191	1.524	1.143	4.307	94.0L	Site 5AB - 141+151 Stanley Ave
W	BE20059	Jun 18 /18 09:54:29	0.889	0.635	0.254	0.898	4.191	0.635	0.762	4.307	94.0L	Site 5AB - 141+151 Stanley Ave
H	BE20059	Jun 18 /18 09:57:01	4.064	2.286	0.254	4.064	1.524	0.635	0.762	1.529	94.0L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 09:58:22	10.03	4.064	4.572	11.75	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 09:58:52	10.03	4.064	4.572	11.75	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 10:01:48	2.032	5.080	2.286	5.607	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 10:03:51	1.016	5.080	2.286	5.607	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jun 18 /18 10:05:59	4.064	0.762	0.254	4.064	0.889	0.508	0.635	0.959	91.5L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 18 /18 10:06:50	4.445	1.778	2.413	5.361	0.508	0.254	0.381	0.508	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 18 /18 10:08:31	1.397	0.889	0.381	1.403	1.397	0.762	0.762	1.408	117.2L	Site 5AB - 141+151 Stanley Ave
W	BE16212	Jun 18 /18 10:11:31	4.445	1.778	2.413	5.361	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 10:14:30	4.064	1.905	2.794	4.972	0.762	0.508	0.635	0.852	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 13:35:02	4.064	0.635	2.794	4.972	0.381	0.254	0.254	0.440	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 13:38:02	3.302	5.842	4.826	7.645	1.143	0.508	0.889	1.157	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 18 /18 15:49:14	1.016	5.842	4.826	7.645	0.508	0.254	0.381	0.582	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 15:51:31	5.080	2.032	2.286	5.680	0.508	0.381	0.508	0.582	***	Site 5A - IOS Shaft IOS Location

**CSST - Site 5
M7550A DTJV
June 18, 2018 to June 24, 2018**

Event Report: Event List - z:\to be archived\2 csst temp folders\site 5

Type	Serial No.	Date/Time	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	PVS1 (mm/s)	Tran2 Peak (mm/s)	Vert2 Peak (mm/s)	Long2 Peak (mm/s)	PVS2 (mm/s)	Mic Peak (dB)	Description
W	BE16212	Jun 18 /18 16:19:16	5.080	1.524	2.032	5.680	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 18 /18 16:22:14	2.921	2.921	3.429	4.969	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
H	BE22085	Jun 19 /18 06:06:50	1.016	1.016	1.270	1.397	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Jun 19 /18 06:06:54	0.762	0.381	0.635	0.783	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20059	Jun 19 /18 06:07:01	0.889	0.889	0.254	0.933	1.397	0.762	1.016	1.442	114.0L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Jun 19 /18 06:07:33	2.286	2.667	2.413	3.438	0.635	0.381	0.508	0.660	***	Site 5A - IOS Shaft IOS Location
H	BE18786	Jun 19 /18 06:07:34	0.762	0.635	0.762	0.898	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE16212	Jun 20 /18 06:05:22	3.048	2.794	2.794	3.485	0.508	0.508	0.508	0.648	***	Site 5A - IOS Shaft IOS Location
H	BE18786	Jun 20 /18 06:05:22	0.635	0.635	0.762	1.000	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE22085	Jun 20 /18 06:05:22	0.762	0.508	1.270	1.368	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Jun 20 /18 06:06:03	0.762	0.381	0.508	0.861	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20059	Jun 20 /18 06:06:12	1.270	2.794	3.683	4.414	1.778	0.762	1.524	1.823	110.9L	Site 5AB - 141+151 Stanley Ave
H	MP12604	Jun 20 /18 09:05:37	0.536	0.465	0.891	1.093	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	MP12604	Jun 21 /18 06:06:03	0.189	0.307	0.244	0.349	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE22085	Jun 21 /18 06:07:03	0.762	0.508	0.635	0.861	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE18786	Jun 21 /18 06:07:04	0.635	0.635	0.635	0.852	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE17376	Jun 21 /18 06:07:08	0.635	0.508	0.508	0.751	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE16212	Jun 21 /18 06:07:11	2.286	2.413	2.286	3.888	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 21 /18 06:07:20	0.889	0.762	0.381	0.889	1.143	0.762	1.143	1.212	110.9L	Site 5AB - 141+151 Stanley Ave
H	MP12604	Jun 22 /18 06:06:04	0.260	0.307	0.331	0.367	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE22085	Jun 22 /18 06:06:50	0.762	0.762	1.397	1.454	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Jun 22 /18 06:06:54	1.397	0.254	1.016	1.408	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE18786	Jun 22 /18 06:06:54	1.016	0.762	1.143	1.529	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE16212	Jun 22 /18 06:06:56	2.413	2.159	3.048	4.152	0.508	1.016	0.381	1.078	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 22 /18 06:07:44	0.889	0.762	0.381	0.898	1.651	0.762	1.143	1.690	102.8L	Site 5AB - 141+151 Stanley Ave
H	MP12604	Jun 23 /18 06:06:04	0.166	0.221	0.331	0.343	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE18786	Jun 23 /18 06:06:54	0.762	0.762	1.016	1.198	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE16212	Jun 23 /18 06:06:55	1.905	2.667	3.683	4.241	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jun 23 /18 06:07:04	0.762	0.762	0.254	0.813	1.143	0.762	1.651	1.732	110.6L	Site 5AB - 141+151 Stanley Ave
H	BE22085	Jun 23 /18 06:07:32	0.254	0.254	0.254	0.440	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Jun 23 /18 06:07:33	0.254	0.381	0.381	0.475	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	MP12604	Jun 24 /18 06:06:04	0.173	0.142	0.181	0.201	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE22085	Jun 24 /18 06:06:52	0.381	0.254	0.381	0.524	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE20059	Jun 24 /18 06:07:03	0.762	0.762	0.381	0.813	2.032	0.762	1.397	2.064	110.6L	Site 5AB - 141+151 Stanley Ave
H	BE18786	Jun 24 /18 06:07:32	0.508	0.635	0.508	0.813	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE17376	Jun 24 /18 06:07:34	0.381	0.127	0.254	0.421	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE16212	Jun 24 /18 06:07:36	3.048	1.651	4.826	5.848	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jun 24 /18 18:35:53	3.048	1.270	4.826	5.848	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jun 24 /18 18:38:15	1.651	2.032	2.159	2.318	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location