



Specialists in Explosives, Blasting and Vibration
Consulting Engineers

April 30, 2018

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

Attention: Mr. Kevin Stadelmann

Re: Interim Weekly Vibration Monitoring Report – April 23 to April 29, 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 5A Location** (Borehole and Surface) – Installed on Sept 5, 2017
- **IOS Shaft IOS Location** (Borehole and Surface) – Installed on Oct 13, 2017

EXPLOTECH

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 7	IOS Shaft 5A – Surface	April 24, 2018	8:06 to 16:51	Up to 7.493	Transient Source	N/A – Surface is for information purposes only
8 to 9	IOS Shaft 5A – Surface	April 25, 2018	11:04 to 11:27	Up to 5.080	Transient Source	N/A – Surface is for information purposes only
10 to 15	151 Stanley Avenue	April 25, 2018	13:18 to 20:44	Up to 5.715	RF / Power Spikes	N/A – Not Construction Related
16 to 19	151 Stanley Avenue	April 26, 2018	8:16 to 16:39	Up to 5.461	RF / Power Spikes	N/A – Not Construction Related
20 to 25	151 Stanley Avenue	April 28, 2018	5:33 to 9:08	Up to 5.969	RF / Power Spikes	N/A – Not Construction Related

EXPLOTECH

Site 5C						
26	51 Queen Victoria Street	Apr 25, 2018	7:09	4.318	Transient Source	Below Threshold Value
27	50 Queen Victoria Street	Apr 25, 2018	15:41	4.826	Localized Impact	Below Threshold Value

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
April 23, 2018 to April 29, 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
H	BE16212	Apr 22 /18 06:07:10	0.889	0.762	1.143	1.571	0.381	0.381	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Apr 23 /18 06:01:54	0.762	1.016	0.762	1.150	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE22085	Apr 23 /18 06:06:50	1.651	1.905	2.032	2.345	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE17376	Apr 23 /18 06:06:54	1.905	1.651	1.397	1.913	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE20059	Apr 23 /18 06:07:03	0.889	0.889	0.381	0.976	1.143	0.635	0.889	1.157	114.6L	Site 5AB - 141+151 Stanley Avenue
H	BE18786	Apr 23 /18 06:07:34	1.270	1.651	1.143	1.778	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE20061	Apr 23 /18 06:07:34	0.254	0.254	0.254	0.381	1.778	2.667	2.159	3.082	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Apr 23 /18 06:21:12	2.286	2.032	1.397	2.618	2.286	2.921	2.286	3.292	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Apr 24 /18 06:01:52	0.381	0.381	0.381	0.421	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE18786	Apr 24 /18 06:06:51	1.016	0.889	0.762	1.374	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE20061	Apr 24 /18 06:06:54	0.254	0.254	0.254	0.311	6.096	3.937	5.080	7.839	***	Site 5A - IOS Shaft 5A Location
H	BE20059	Apr 24 /18 06:07:04	0.889	0.889	0.635	1.032	1.397	0.635	1.270	1.408	115.2L	Site 5AB - 141+151 Stanley Avenue
H	BE22085	Apr 24 /18 06:07:32	2.159	2.667	2.032	2.902	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE16212	Apr 24 /18 06:07:55	1.651	1.524	1.524	2.004	0.635	0.381	0.635	0.730	***	Site 5A - IOS Shaft IOS Location
H	BE17376	Apr 24 /18 06:10:21	1.016	0.889	0.508	1.107	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
W	BE20061	Apr 24 /18 08:06:32	0.254	0.254	0.254	0.284	6.096	3.937	5.080	7.839	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 08:08:49	0.254	0.254	0.254	0.311	4.572	5.715	2.540	6.382	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 08:14:53	0.254	0.254	0.254	0.284	4.572	5.715	2.540	6.382	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 08:19:53	0.254	0.254	0.254	0.311	4.318	3.175	3.175	5.433	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 08:34:37	0.254	0.254	0.254	0.311	4.318	1.905	3.175	5.433	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 08:36:53	0.254	0.254	0.254	0.359	6.985	7.493	7.366	9.069	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 11:20:04	0.254	0.254	0.254	0.311	6.985	7.493	7.366	9.069	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 11:22:22	0.254	0.254	0.254	0.381	5.334	3.937	3.556	5.867	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 15:41:58	0.254	0.254	0.254	0.311	5.334	3.937	2.413	5.867	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 15:44:18	0.254	0.254	0.254	0.359	3.302	3.683	4.699	4.749	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 16:44:37	0.254	0.254	0.254	0.284	1.778	2.032	4.699	4.749	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 16:46:53	0.254	0.254	0.254	0.311	2.667	4.191	2.667	4.720	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 24 /18 16:51:08	0.254	0.254	0.254	0.311	2.667	4.191	2.667	4.720	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 24 /18 16:53:25	0.254	0.254	0.254	0.381	1.397	2.286	1.778	2.508	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Apr 25 /18 06:01:52	0.381	0.508	0.381	0.660	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE22085	Apr 25 /18 06:06:50	4.826	4.572	1.143	5.202	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE18786	Apr 25 /18 06:06:52	1.397	0.889	1.397	1.581	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE16212	Apr 25 /18 06:06:58	1.270	1.397	1.397	2.349	1.270	0.635	1.016	1.301	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Apr 25 /18 06:07:04	0.889	0.889	0.254	0.976	4.191	0.508	1.016	4.201	147.7L	Site 5AB - 141+151 Stanley Avenue
H	BE17376	Apr 25 /18 06:07:09	4.318	1.270	2.413	4.327	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE20061	Apr 25 /18 06:10:21	0.254	0.254	0.254	0.359	2.794	5.080	4.699	5.951	***	Site 5A - IOS Shaft 5A Location
W	BE17376	Apr 25 /18 07:09:10	4.318	1.270	2.413	4.327	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE17376	Apr 25 /18 07:11:45	1.016	0.508	0.508	1.032	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
W	BE20061	Apr 25 /18 11:04:02	0.254	0.254	0.254	0.284	2.413	5.080	4.699	5.951	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 25 /18 11:07:22	0.254	0.254	0.254	0.311	4.318	3.302	3.810	4.597	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Apr 25 /18 11:27:03	0.254	0.127	0.254	0.284	4.318	3.302	1.905	4.385	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Apr 25 /18 11:30:06	0.381	0.381	0.254	0.402	1.651	1.905	1.905	2.148	***	Site 5A - IOS Shaft 5A Location
W	BE20059	Apr 25 /18 13:18:19	0.762	0.635	0.254	0.813	4.191	0.381	0.762	4.201	147.7L	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 13:20:55	0.889	0.762	0.254	0.933	4.318	0.508	0.889	4.322	147.7L	Site 5AB - 141+151 Stanley Avenue
W	BE20059	Apr 25 /18 13:25:53	0.762	0.762	0.254	0.813	4.318	0.508	0.762	4.322	147.7L	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 13:28:26	0.889	1.016	0.254	1.016	5.715	0.508	1.397	5.715	***	Site 5AB - 141+151 Stanley Avenue
W	BE22085	Apr 25 /18 15:41:16	4.826	4.572	1.143	5.202	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE22085	Apr 25 /18 15:43:15	0.254	0.254	0.254	0.381	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
W	BE20059	Apr 25 /18 15:46:07	0.762	0.635	0.254	0.813	5.715	0.508	0.635	5.715	***	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 15:48:40	0.889	0.889	0.254	0.976	4.318	0.508	1.016	4.320	147.9L	Site 5AB - 141+151 Stanley Avenue
W	BE20059	Apr 25 /18 17:22:33	0.762	0.762	0.254	0.803	4.318	0.381	0.762	4.320	147.9L	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 17:25:07	0.889	0.889	0.254	0.976	3.937	0.635	0.889	3.941	147.1L	Site 5AB - 141+151 Stanley Avenue
W	BE20059	Apr 25 /18 20:39:20	0.762	0.762	0.254	0.813	3.937	0.381	0.762	3.941	147.1L	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 20:41:53	0.889	0.762	0.254	0.898	4.191	0.508	0.889	4.199	147.8L	Site 5AB - 141+151 Stanley Avenue
W	BE20059	Apr 25 /18 20:44:15	0.762	0.635	0.254	0.803	4.191	0.508	0.762	4.199	147.8L	Site 5AB - 141+151 Stanley Avenue
H	BE20059	Apr 25 /18 20:46:49	1.016	0.889	0.254	1.092	1.905	0.635	1.397	1.905	140.2L	Site 5AB - 141+151 Stanley Avenue
H	BE15997	Apr 26 /18 06:01:52	0.254	0.254	0.381	0.421	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE22085	Apr 26 /18 06:06:49	0.762	0.762	0.762	1.000	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE18786	Apr 26 /18 06:06:52	0.635	0.762	0.635	0.852	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE17376	Apr 26 /18 06:06:54	1.397	0.381	1.016	1.626	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE20059	Apr 26 /18 06:06:57	1.016	1.016	0.254	1.032	3.937	0.635	1.397	3.939	147.1L	Site 5AB - 141+151 Stanley Avenue
H	BE20061	Apr 26 /18 06:07:34	0.381	0.381	0.254	0.421	1.524	2.032	1.016	2.203	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Apr 26 /18 06:08:21	2.794	2.794	2.667	3.797	0.889	0.381	0.889	1.171	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Apr 26 /18 08:16:36	0.762	0.635	0.254	0.773	3.937	0.381	0.635	3.939	147.1L	Site 5AB - 141+151 Stanley Avenue

**CSST - Site 5
M7550A DTJV
April 23, 2018 to April 29, 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
H	BE20059	Apr 26 /18 08:19:11	0.889	0.889	0.254	0.976	5.461	0.508	0.889	5.485	***	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 26 /18 09:35:30	0.762	0.635	0.254	0.813	5.461	0.508	0.762	5.485	***	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 26 /18 09:38:02	0.889	0.889	0.254	0.976	4.064	0.508	0.889	4.072	147.1L	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 26 /18 12:13:56	0.889	0.635	0.254	0.933	4.064	0.508	0.762	4.072	147.1L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 26 /18 12:16:30	0.889	0.889	0.381	0.976	4.572	3.810	4.318	5.502	115.6L	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 26 /18 16:39:13	0.762	0.635	0.254	0.783	4.572	3.810	4.318	5.502	91.5L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 26 /18 16:41:48	1.143	0.889	0.381	1.178	1.905	0.508	1.778	1.909	112.0L	Site 5AB - 141+151 Stanley Aven
H	BE15997	Apr 27 /18 06:01:54	0.508	0.762	0.508	0.898	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	BE22085	Apr 27 /18 06:06:52	1.143	1.143	1.270	1.391	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	BE17376	Apr 27 /18 06:06:54	1.143	1.016	0.889	1.198	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
H	BE18786	Apr 27 /18 06:06:54	0.762	0.762	0.889	1.092	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE16212	Apr 27 /18 06:06:55	2.032	3.048	1.905	3.265	0.762	0.254	0.635	0.852	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Apr 27 /18 06:07:00	1.016	1.016	0.508	1.032	4.318	0.635	2.159	4.327	147.7L	Site 5AB - 141+151 Stanley Aven
H	BE20061	Apr 27 /18 06:07:34	0.381	0.254	0.254	0.421	1.016	1.016	0.635	1.264	***	Site 5A - IOS Shaft 5A Location
W	BE20059	Apr 28 /18 05:33:22	0.762	0.635	0.254	0.842	4.318	0.508	0.635	4.327	147.7L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 05:36:04	0.762	0.635	0.254	0.813	5.969	0.508	0.889	5.970	***	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 28 /18 05:40:09	0.635	0.635	0.254	0.696	5.969	0.508	0.889	5.970	***	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 05:42:41	0.889	0.762	0.254	0.933	3.937	0.508	0.762	3.939	145.2L	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 28 /18 05:43:49	0.889	0.762	0.254	0.933	3.937	0.508	0.762	3.939	145.2L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 05:46:20	0.889	0.762	0.254	0.933	3.810	0.508	0.889	3.814	146.8L	Site 5AB - 141+151 Stanley Aven
H	BE15997	Apr 28 /18 06:02:35	0.381	0.254	0.508	0.648	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	BE20059	Apr 28 /18 06:06:52	0.889	0.889	0.254	0.976	3.937	0.635	1.397	3.947	147.0L	Site 5AB - 141+151 Stanley Aven
H	BE22085	Apr 28 /18 06:06:52	1.778	0.762	0.762	1.854	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	BE18786	Apr 28 /18 06:06:53	0.762	0.635	0.635	0.823	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE16212	Apr 28 /18 06:06:55	2.540	1.397	3.048	3.389	0.381	0.381	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE20061	Apr 28 /18 06:06:55	0.381	0.254	0.254	0.421	0.381	0.381	0.381	0.554	***	Site 5A - IOS Shaft 5A Location
H	BE17376	Apr 28 /18 06:07:35	0.635	0.381	0.508	0.741	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
W	BE20059	Apr 28 /18 07:08:18	0.762	0.635	0.254	0.813	3.937	0.508	0.889	3.947	147.0L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 07:10:49	1.016	0.889	0.762	1.032	4.318	0.635	1.397	4.320	147.9L	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 28 /18 08:48:46	0.762	0.762	0.254	0.813	4.318	0.508	0.635	4.320	147.9L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 08:51:19	0.889	0.889	0.254	0.933	4.318	0.508	0.889	4.325	147.9L	Site 5AB - 141+151 Stanley Aven
W	BE20059	Apr 28 /18 09:08:35	0.762	0.762	0.254	0.813	4.318	0.508	0.635	4.325	147.9L	Site 5AB - 141+151 Stanley Aven
H	BE20059	Apr 28 /18 09:11:46	1.143	1.016	1.143	1.454	3.175	0.762	3.429	3.450	145.1L	Site 5AB - 141+151 Stanley Aven
H	BE15997	Apr 29 /18 06:02:35	0.254	0.254	0.254	0.381	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	BE18786	Apr 29 /18 06:06:52	0.508	0.508	0.508	0.762	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE22085	Apr 29 /18 06:06:52	0.381	0.381	0.254	0.475	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	BE20059	Apr 29 /18 06:07:01	1.016	1.016	0.381	1.264	1.905	0.635	1.651	1.922	117.9L	Site 5AB - 141+151 Stanley Aven
H	BE17376	Apr 29 /18 06:07:34	0.381	0.254	0.254	0.524	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
H	BE20061	Apr 29 /18 06:07:34	0.381	0.381	0.254	0.458	0.254	0.381	0.254	0.421	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Apr 29 /18 06:09:13	1.778	1.524	2.540	3.275	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location