



Specialists in Explosives, Blasting and Vibration
Consulting Engineers

November 27, 2017

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

Attention: Mr. Kevin Stadelmann

**Re: Interim Weekly Vibration Monitoring Report – November 20 to November 26, 2017
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
- **133 Stanley Avenue** – Installed on August 4, 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



Site 5C

- **54 Queen Victoria Street** – Installed on March 31, 2017
- **51 Queen Victoria Street** – Installed on April 11, 2017

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	IOS Shaft 5A - Borehole	Nov 20, 2017	15:52	7.239	Blasting	Below Threshold Value
2	IOS Shaft 5A - Surface	Nov 22, 2017	11:53	4.191	Localized Impacts	N/A – Surface is for information purposes only
3	IOS Shaft 5A - Borehole	Nov 22, 2017	12:52	9.017	Blasting	Below Threshold Value
4	IOS Shaft 5A - Surface	Nov 23, 2017	7:10	4.572	Localized Impacts	N/A – Surface is for information purposes only
5	IOS Shaft 5A - Surface	Nov 24, 2017	7:12	6.731	Localized Impacts	N/A – Surface is for information purposes only
Site 5C						
6	51 Queen Victoria	Nov 21, 2017	13:38	4.953	Transient Source	Below Threshold Value
7 to 15	51 Queen Victoria	Nov 24, 2017	14:55 to 15:30	Up to 8.636	Transient Source	Response Value

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
Nov 20, 2017 to Nov 26, 2017**

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	BE15997	Nov 20 /17 06:01:54	1.397	1.778	1.651	2.189	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE17376	Nov 20 /17 06:06:53	2.921	1.905	2.540	3.429	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20061	Nov 20 /17 06:06:54	7.239	6.477	4.699	9.176	0.889	2.794	2.667	2.808	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Nov 20 /17 06:06:55	1.651	0.889	1.270	1.661	0.635	0.889	0.508	0.925	***	Site 5A - IOS Shaft IOS Location
H	BE11685	Nov 20 /17 06:06:57	0.508	0.635	0.508	0.823	***	***	***	***	108.8L	Site 5AB - 133 Stanley Avenue
H	BE14293	Nov 20 /17 09:02:58	1.016	1.270	1.016	1.690	2.286	1.016	2.032	2.321	114.2L	Site 5AB - 141+151 Stanley Ave
W	BE20061	Nov 20 /17 15:52:05	7.239	6.477	4.699	9.176	0.889	1.778	2.667	2.785	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 20 /17 15:54:16	0.381	0.381	0.254	0.402	0.254	0.381	0.254	0.402	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Nov 21 /17 06:01:53	0.508	0.381	0.381	0.568	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE17376	Nov 21 /17 06:06:55	4.953	2.540	2.159	5.202	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE16212	Nov 21 /17 06:06:57	1.016	1.270	1.143	1.670	0.508	0.381	0.381	0.635	***	Site 5A - IOS Shaft IOS Location
H	BE11685	Nov 21 /17 06:07:37	0.381	0.254	0.381	0.475	***	***	***	***	105.5L	Site 5AB - 133 Stanley Avenue
H	BE14293	Nov 21 /17 06:07:44	1.143	1.143	0.381	1.150	2.032	2.413	2.286	2.992	121.5L	Site 5AB - 141+151 Stanley Ave
H	BE20061	Nov 21 /17 06:09:45	0.381	0.381	0.254	0.475	0.635	2.032	0.889	2.098	***	Site 5A - IOS Shaft 5A Location
W	BE17376	Nov 21 /17 13:38:01	4.953	2.540	2.159	5.202	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 21 /17 13:40:00	0.635	0.381	0.508	0.696	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE15997	Nov 22 /17 06:02:33	0.381	0.508	0.254	0.539	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE17376	Nov 22 /17 06:06:50	0.762	0.254	0.254	0.813	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE14293	Nov 22 /17 06:07:06	0.889	0.889	0.381	0.976	2.159	1.016	1.524	2.232	114.8L	Site 5AB - 141+151 Stanley Ave
H	BE20061	Nov 22 /17 06:07:34	0.381	0.381	0.254	0.421	3.556	4.191	3.175	4.269	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Nov 22 /17 06:07:39	1.397	0.762	1.143	1.420	0.635	0.635	0.635	0.741	***	Site 5A - IOS Shaft IOS Location
H	BE11685	Nov 22 /17 06:10:51	0.381	0.381	0.254	0.475	***	***	***	***	102.8L	Site 5AB - 133 Stanley Avenue
W	BE20061	Nov 22 /17 11:53:30	0.254	0.254	0.254	0.311	1.016	4.191	2.159	4.269	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 22 /17 11:55:40	9.017	7.239	5.842	11.66	1.016	1.270	2.413	2.609	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Nov 22 /17 12:52:52	9.017	7.239	5.842	11.66	1.016	1.270	2.413	2.609	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 22 /17 13:00:21	0.381	0.381	0.254	0.458	2.540	2.413	3.556	3.601	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Nov 23 /17 06:01:54	0.254	0.254	0.254	0.381	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE11685	Nov 23 /17 06:06:56	0.508	0.381	0.381	0.684	***	***	***	***	107.5L	Site 5AB - 133 Stanley Avenue
H	BE16212	Nov 23 /17 06:06:56	1.778	1.143	1.524	2.247	0.635	0.762	0.254	0.773	***	Site 5A - IOS Shaft IOS Location
H	BE17376	Nov 23 /17 06:06:56	0.762	0.381	0.254	0.813	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE14293	Nov 23 /17 06:07:06	0.889	1.016	0.254	1.024	2.032	0.508	1.524	2.083	121.4L	Site 5AB - 141+151 Stanley Ave
H	BE20061	Nov 23 /17 06:07:31	0.381	0.381	0.254	0.402	2.032	4.572	1.778	4.618	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Nov 23 /17 07:10:51	0.254	0.254	0.127	0.284	2.032	4.572	1.778	4.618	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 23 /17 07:12:54	0.381	0.381	0.254	0.458	2.667	2.921	1.651	3.215	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Nov 24 /17 06:02:32	0.635	0.508	0.508	0.660	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE17376	Nov 24 /17 06:06:54	8.636	1.651	2.921	8.778	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE11685	Nov 24 /17 06:06:55	0.254	0.254	0.254	0.311	***	***	***	***	111.5L	Site 5AB - 133 Stanley Avenue
H	BE20061	Nov 24 /17 06:07:37	0.381	0.381	0.254	0.421	2.540	2.286	6.731	6.925	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Nov 24 /17 06:07:46	0.889	0.889	0.254	0.933	1.270	0.635	1.016	1.295	124.2L	Site 5AB - 141+151 Stanley Ave
H	BE16212	Nov 24 /17 06:14:10	0.889	1.524	0.889	1.524	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE20061	Nov 24 /17 07:12:08	0.254	0.254	0.127	0.311	2.540	2.286	6.731	6.925	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 24 /17 07:15:00	0.381	0.762	0.508	0.773	2.921	2.413	2.286	3.635	***	Site 5A - IOS Shaft 5A Location
W	BE17376	Nov 24 /17 14:55:54	8.636	1.651	2.921	8.778	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 14:58:37	7.112	3.810	7.874	8.538	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:05:40	7.112	3.810	7.874	8.538	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:07:39	3.937	1.524	2.032	4.117	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:08:29	3.937	1.524	2.032	4.117	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:10:26	5.207	2.286	5.969	6.793	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:11:12	5.207	2.286	5.969	6.793	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:13:09	4.191	1.778	2.413	4.216	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:14:30	4.191	1.651	1.778	4.216	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:16:27	3.556	1.270	4.826	5.182	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:19:33	3.556	0.508	4.826	5.182	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:21:31	4.318	0.635	3.937	5.437	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:22:10	4.318	0.635	3.937	5.437	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:24:07	4.572	0.762	3.683	5.244	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:26:03	4.572	0.762	3.683	5.244	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:28:01	4.318	0.635	3.175	4.604	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
W	BE17376	Nov 24 /17 15:30:11	4.318	0.635	3.175	4.604	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE17376	Nov 24 /17 15:32:07	0.762	0.254	0.254	0.783	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE15997	Nov 25 /17 06:01:52	0.508	0.254	0.254	0.524	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE16212	Nov 25 /17 06:06:56	0.889	1.016	0.635	1.403	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE14293	Nov 25 /17 06:07:04	0.889	0.889	0.508	0.976	1.016	0.508	0.889	1.100	114.8L	Site 5AB - 141+151 Stanley Ave
H	BE17376	Nov 25 /17 06:07:30	0.508	0.254	0.254	0.539	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre

**CSST - Site 5
M7550A DTJV
Nov 20, 2017 to Nov 26, 2017**

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	BE20061	Nov 25 /17 06:07:34	0.381	0.635	0.254	0.660	0.254	0.381	0.254	0.421	***	Site 5A - IOS Shaft 5A Location
H	BE11685	Nov 25 /17 06:07:36	0.254	0.254	0.254	0.284	***	***	***	***	106.0L	Site 5AB - 133 Stanley Avenue
H	BE15997	Nov 26 /17 06:01:54	0.254	0.254	0.254	0.381	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE17376	Nov 26 /17 06:06:53	0.635	0.254	0.254	0.696	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20061	Nov 26 /17 06:06:56	0.381	0.381	0.254	0.475	0.254	0.381	0.254	0.402	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Nov 26 /17 06:07:07	1.397	2.032	1.397	2.118	2.540	0.508	2.540	2.593	116.4L	Site 5AB - 141+151 Stanley Ave
H	BE11685	Nov 26 /17 06:07:33	0.254	0.254	0.381	0.475	***	***	***	***	106.5L	Site 5AB - 133 Stanley Avenue
H	BE16212	Nov 26 /17 06:07:35	0.762	0.635	0.635	1.178	0.381	0.381	0.254	0.421	***	Site 5A - IOS Shaft IOS Location