EXPLOTECH

Specialists in Explosives, Blasting and Vibration
Consulting Engineers

March 5, 2018

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

Attention: Mr. Kevin Stadelmann

Re: Interim Weekly Vibration Monitoring Report – February 26 to March 4, 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 predicable 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
- **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	**IOS Shaft 5A – Surface**	Feb 26, 2018	21:37	**16.38**	**Transient**	Surface for Information Purposes Only
2	**IOS Shaft IOS – Borehole**	Feb 28, 2018	20:45	**4.445**	**RF / Power Spikes**	N/A – Not Construction Related
3	**IOS Shaft 5A – Surface**	Mar 1, 2018	14:10	**5.207**	**Transient**	Surface for Information Purposes Only
4	**IOS Shaft 5A – Surface**	Mar 2, 2018	8:15	**4.699**	**Transient**	Surface for Information Purposes Only

Site 5C						
N/A	No Events	N/A	N/A	N/A	N/A	N/A

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
Feb 26, 2018 to Mar 4, 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	BE15997	Feb 26 /18 06:01:54	1.270	1.270	1.524	1.694	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE20061	Feb 26 /18 06:06:54	0.254	0.254	0.254	0.359	5.969	16.38	8.001	19.18	***	Site 5A - IOS Shaft 5A Location
H	BE10735	Feb 26 /18 06:06:55	0.381	0.508	0.254	0.539	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE16212	Feb 26 /18 06:06:55	1.143	2.921	1.143	2.948	0.508	0.635	0.254	0.696	***	Site 5A - IOS Shaft IOS Location
H	BE17376	Feb 26 /18 06:06:56	0.508	0.889	0.635	1.092	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE14293	Feb 26 /18 06:07:05	1.016	1.016	0.381	1.024	2.413	0.635	2.159	2.446	123.3L	Site 5AB - 141+151 Stanley Ave
H	BE18786	Feb 26 /18 06:07:32	0.762	2.032	1.016	2.229	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE15757	Feb 26 /18 06:08:03	0.381	0.254	0.254	0.421	***	***	***	***	123.7L	Site 5AB - 133 Stanley Avenue
W	BE20061	Feb 26 /18 21:37:43	0.254	0.254	0.254	0.311	5.969	16.38	8.001	19.18	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Feb 26 /18 21:42:42	0.254	0.254	0.254	0.359	0.381	1.397	0.889	1.426	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Feb 27 /18 06:04:57	0.889	0.381	1.016	1.085	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE10735	Feb 27 /18 06:06:56	0.381	0.508	0.381	0.596	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE14293	Feb 27 /18 06:07:05	0.889	1.143	0.254	1.143	2.667	0.635	2.159	2.682	118.3L	Site 5AB - 141+151 Stanley Ave
H	BE15757	Feb 27 /18 06:07:19	0.381	0.254	0.254	0.402	***	***	***	***	115.6L	Site 5AB - 133 Stanley Avenue
H	BE20061	Feb 27 /18 06:07:29	0.381	0.254	0.254	0.402	0.381	2.032	0.762	2.071	***	Site 5A - IOS Shaft 5A Location
H	BE17376	Feb 27 /18 06:07:34	0.381	0.254	0.635	0.696	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE18786	Feb 27 /18 06:07:34	0.508	0.508	0.635	0.898	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE16212	Feb 27 /18 06:09:22	1.778	2.032	1.397	2.534	0.635	2.794	0.381	2.806	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Feb 28 /18 06:01:55	0.889	0.508	0.508	0.976	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE18786	Feb 28 /18 06:06:53	0.635	1.270	0.762	1.350	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE16212	Feb 28 /18 06:06:54	2.540	4.445	3.683	4.794	0.508	0.381	0.254	0.508	***	Site 5A - IOS Shaft IOS Location
H	BE17376	Feb 28 /18 06:06:56	0.381	0.254	0.508	0.539	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE14293	Feb 28 /18 06:07:08	1.016	1.143	0.381	1.150	2.540	0.635	2.159	2.572	110.9L	Site 5AB - 141+151 Stanley Ave
H	BE15757	Feb 28 /18 06:07:21	0.381	0.254	0.254	0.381	***	***	***	***	108.8L	Site 5AB - 133 Stanley Avenue
H	BE10735	Feb 28 /18 06:07:34	0.381	0.508	0.508	0.539	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE20061	Feb 28 /18 06:07:37	0.381	0.254	0.254	0.421	0.635	2.921	0.762	2.989	***	Site 5A - IOS Shaft 5A Location
W	BE16212	Feb 28 /18 20:45:27	1.270	4.445	1.270	4.794	0.254	0.254	0.254	0.311	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Feb 28 /18 20:47:49	2.413	2.159	2.413	3.494	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Mar 1 /18 06:01:53	0.508	0.635	0.635	0.823	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE18786	Mar 1 /18 06:06:52	0.635	1.778	1.270	1.854	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE10735	Mar 1 /18 06:06:56	0.508	0.762	0.381	0.803	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE14293	Mar 1 /18 06:07:06	1.016	1.143	0.381	1.157	3.175	0.635	2.413	3.240	117.9L	Site 5AB - 141+151 Stanley Ave
H	BE17376	Mar 1 /18 06:07:34	0.635	1.016	0.508	1.205	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE15757	Mar 1 /18 06:10:21	0.381	0.254	0.381	0.402	***	***	***	***	105.5L	Site 5AB - 133 Stanley Avenue
H	BE20061	Mar 1 /18 06:10:34	0.381	0.254	0.254	0.402	0.889	5.207	1.016	5.247	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Mar 1 /18 14:10:52	0.254	0.254	0.254	0.311	0.889	5.207	1.016	5.247	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Mar 1 /18 14:13:14	0.381	0.381	0.254	0.421	0.381	0.889	0.381	0.907	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Mar 2 /18 06:02:32	0.889	1.651	0.889	1.836	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE20061	Mar 2 /18 06:06:51	0.254	0.254	0.254	0.359	0.762	4.699	0.635	4.716	***	Site 5A - IOS Shaft 5A Location
H	BE18786	Mar 2 /18 06:06:54	0.762	1.651	0.762	1.746	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE10735	Mar 2 /18 06:06:55	0.635	1.651	0.508	1.737	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Mar 2 /18 06:07:34	0.508	0.635	0.381	0.852	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE15757	Mar 2 /18 06:07:45	0.254	0.254	0.254	0.381	***	***	***	***	114.6L	Site 5AB - 133 Stanley Avenue
H	BE14293	Mar 2 /18 06:07:46	1.016	1.143	0.381	1.205	2.794	0.635	2.286	2.823	123.4L	Site 5AB - 141+151 Stanley Ave
W	BE20061	Mar 2 /18 08:15:17	0.254	0.254	0.254	0.284	0.762	4.699	0.635	4.716	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Mar 2 /18 08:23:17	0.381	0.254	0.381	0.402	0.381	1.270	0.381	1.283	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Mar 3 /18 06:01:54	0.762	0.635	0.762	0.950	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE20061	Mar 3 /18 06:06:54	0.254	0.254	0.254	0.381	0.254	0.381	0.254	0.421	***	Site 5A - IOS Shaft 5A Location
H	BE15757	Mar 3 /18 06:07:21	0.381	0.254	0.381	0.421	***	***	***	***	110.2L	Site 5AB - 133 Stanley Avenue
H	BE18786	Mar 3 /18 06:07:34	0.508	0.889	0.508	1.040	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE10735	Mar 3 /18 06:07:36	0.381	0.635	0.381	0.648	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Mar 3 /18 06:07:36	0.381	0.381	0.254	0.402	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE14293	Mar 3 /18 06:07:45	1.016	1.397	0.381	1.408	2.667	0.635	2.413	2.697	114.6L	Site 5AB - 141+151 Stanley Ave
H	BE15997	Mar 4 /18 06:01:54	0.254	0.254	0.254	0.359	***	***	***	***	***	Site 5C - 54 Queen Victoria Stre
H	BE10735	Mar 4 /18 06:06:52	0.254	1.651	0.254	1.661	***	***	***	***	***	Site 5C - 50 Queen Victoria Stre
H	BE17376	Mar 4 /18 06:06:54	0.381	0.254	0.254	0.402	***	***	***	***	***	Site 5C - 51 Queen Victoria Stre
H	BE20061	Mar 4 /18 06:06:56	0.254	0.254	0.254	0.381	0.254	0.381	0.254	0.402	***	Site 5A - IOS Shaft 5A Location
H	BE15757	Mar 4 /18 06:07:19	0.381	0.254	0.254	0.421	***	***	***	***	114.0L	Site 5AB - 133 Stanley Avenue
H	BE18786	Mar 4 /18 06:07:33	0.508	0.889	0.508	0.959	***	***	***	***	***	Site 5C - 55 Queen Victoria Stre
H	BE14293	Mar 4 /18 06:07:46	1.143	2.159	0.381	2.166	2.794	0.635	2.413	2.823	124.2L	Site 5AB - 141+151 Stanley Ave