

LIMITED VIBRATION STUDY

KILLEEN BUSINESS PARK

November 15, 2022 | Report Number: FB226203



Nationwide

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November 15, 2022

Killeen Economic Development Corporation
One Santa Fe Plaza Drive
Killeen, TX 76541

Attn: Ms. Phyllis Gogue
P (254) 526-9551
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E phyllis@gkcc.com

RE: LIMITED VIBRATION STUDY
Killeen Business Park
601 Twin Creek Drive
Killeen, Texas 76543
Terracon Project No. FB226203

Dear Ms. Gogue:

Terracon Consultants, Inc. (Terracon) is pleased to submit this report to **Killeen Economic Development Corporation (Client)** documenting the Limited Vibration Study performed at the above-referenced site. This report summarizes our monitoring activities performed at the site and a discussion of our findings. This work was performed in general accordance with proposal dated October 18, 2022.

Please contact the undersigned if you have any questions regarding the above or if we can be of further assistance. We appreciate the opportunity to work with you on this project.

Sincerely,
Terracon Consultants, Inc.
TBPELS Firm F-3272

Sarah Garza
Project Coordinator
Facilities Engineering Division

Scott Lefton, P.E.
Senior Engineer
Facilities Engineering Division

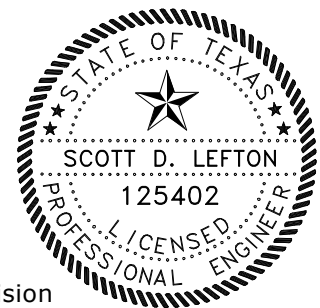


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1.0 PROJECT INFORMATION

The subject area consists of multiple vacant lots located at 601 Twin Creek Drive in Killeen, Texas. The vacant lots are adjacent to the BNSF railroad tracks located along the south side of the property. The schedule of trains using these tracks is unknown. We have been asked to perform a Limited Vibration Study to include measuring the current level of vibrations at select locations of the undeveloped property closest to the existing train tracks as we understand that a future development at this property may include vibration sensitive equipment, processes, or occupancies.

2.0 SCOPE OF SERVICES

Terracon has completed the services discussed in our proposal No. PFB2226203 dated October 18, 2022. The services provided are noted below:

- Baseline Vibration Monitoring – Installed vibration monitors at two location directly next to the existing train track and measured vibrations over the period of Wednesday October 19, 2022 to Wednesday November 2, 2022.
- Reporting – Following the above-mentioned activities, Terracon is issuing this report providing our observations and data collected from the services performed, as well as our recommendations.

3.0 BASELINE VIBRATION MONITORING

Vibrations were monitored at two locations from October 19 – November 2, 2022. Vibration monitoring locations were designated as V-MP-1 and V-MP-2. Photographs of the installed units and their calibrations records, are included in **Attachment A**. The approximate location of each unit is shown on the figure in **Attachment B**. The equipment used for the vibration monitoring consists of *Sigicom C22 Triaxial Geophones*. The ground vibration was monitored in three directions - V, L, and T, which are up-down (vertical - V), approximately parallel to the train tracks - L, and approximately perpendicular to the train tracks - T. Refer to **Attachment C** for equipment specifications utilized on this project.

The vibrations were measured in terms of Vibration Decibels (VdB) referenced to a root-mean-square velocity amplitude of 1×10^6 inches per second. The maximum VdB measured at each monitor in each direction during a two-minute interval has been reported for each vibration monitoring location in use at that time. Refer to **Attachment D** for vibration monitoring data collected at each location during the monitoring period.

V-MP-1

A vibration monitor was installed on the site where indicated in **Attachment B**. This installation was completed on the morning of Monday, October 19, 2022. The installation of monitoring equipment was completed around 11:45 AM. The unit remained installed until around noon on Tuesday, November 2, 2022 when it was removed.

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In general, vibration data collected at the site correlated well to suspected train passings. Terracon personnel were not on site to observe activities causing specific vibration events. Terracon utilized a threshold of 70 Vdb to separate vibrations measured at the site which we believe correlated to train passings. The vibration below is separated at this threshold to assist our Client in interpreting this data. Graphs of frequency vs amplitude is included in **Attachment E**.

A summary of the vibration data collected at this location are presented in the table below:

| Data Collected Without Suspected Trains | | | With Suspected Trains | | | |
|---|------|--------|-----------------------|------|--------|-----------------|
| | Max | Median | | Max | Median | Frequency Range |
| V | 62.4 | 38.4 | V | 93.9 | 85.0 | 22.5-102 Hz |
| L | 67.9 | 49.5 | L | 101 | 89.6 | 22.5-81.9 Hz |
| T | 69.2 | 49.3 | T | 104 | 92.0 | 20.3-58.5 Hz |

V-MP-2

A vibration monitor was installed on the site on the morning of Wednesday, October 19, 2022. The installation of monitoring equipment was completed around 11:45 AM. The unit remained installed until around noon of Tuesday, November 2, 2022 when it was removed.

In general, vibration data collected at the site correlated well to suspected train passings. Terracon personnel were not on site to observe activities causing specific vibration events. Terracon utilized a threshold of 70 Vdb to separate vibrations measured at the site which we believe correlated to train passings. The vibration below is separated at this threshold to assist our Client in interpreting this data. Graphs of frequency vs amplitude is included in **Attachment E**.

The vibrations measured at this location did correlate to train events. A summary of the vibration data collected at this location are presented in the table below:

| Data Collected Without Suspected Trains | | | With Suspected Trains | | | |
|---|------|--------|-----------------------|------|--------|-----------------|
| | Max | Median | | Max | Median | Frequency Range |
| V | 69.5 | 32.4 | V | 89.4 | 83.6 | 25-101 Hz |
| L | 70.0 | 42.3 | L | 96.2 | 91.1 | 71-101 Hz |
| T | 70.0 | 42.5 | T | 101 | 93.2 | 16-66.1 Hz |

4.0 CONCLUSIONS AND RECOMMENDATIONS

Vibrations measured at the site appear to correlate to suspected trains passing. This is likely due to the short distance from the train tracks to the monitoring points. Depending on the specific sensitivity of future equipment being installed vibration control measures may be necessary if vibration sensitive equipment is to be placed close to the train tracks. These vibration control measures may include the use of an elevated foundation platform supported on discrete columns or piers, or the use of an open channel to prevent ground-borne vibrations from reaching sensitive equipment. In any case, future improvements on this portion of the site should be designed with sufficient mass or stiffness to avoid resonance with train-induced vibrations. Terracon should be

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retained to review construction plans for future improvements to the site to determine if train-induced vibrations are anticipated to be problematic given the specific site constraints and planned development. Alternatively, the buildings could be sited further away from the train tracks to provide a greater distance from the source of vibrations to the vibrations-sensitive equipment, processes, or occupancies.

5.0 GENERAL COMMENTS

This report has been prepared for the exclusive use of our Client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices using the standard of care and skill currently exercised by professional engineers practicing in this area, for a project of similar scope and nature. No warranties, either express or implied, are intended or made. It is possible that defects and/or deficiencies exist that were not readily accessible or visible. Problems may develop with time, which were not evident at the time of this study. This Limited Structural Assessment is not intended to serve as a comprehensive assessment of all building components. Given the limited nature of our observations, this report should not be used for comprehensive repair design decisions or cost estimating. In the event that information described in this document which was provided by others is incorrect, or if additional information becomes available, the conclusions contained in this report shall not be considered valid unless Terracon reviews the information and either verifies or modifies the conclusions of this report in writing.

Furthermore, the data collected as a part of this study is representative of the vibrations induced from train traffic at the time of our study. Changes to the type and frequency of train traffic carried on the adjacent train tracks may change the characteristics of the vibrations induced into the buildings on this site. Although through the course of this study, we attempted to measure vibrations characteristic of the typical rail traffic carried on the adjacent rail lines at the present time, future changes to the rail traffic, such as train speed (faster trains), train weight (heavier trains), improvements or changes to the rails, sleepers, or bedding material, and changes in individual traincar suspension, may warrant additional engineering study.